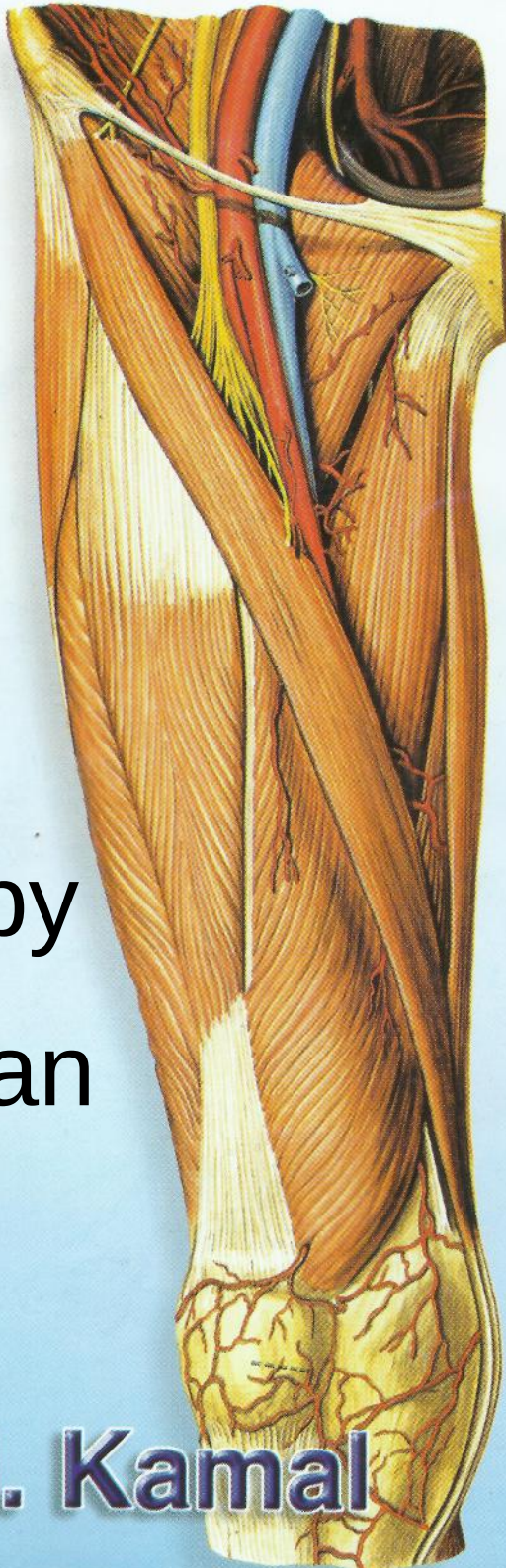
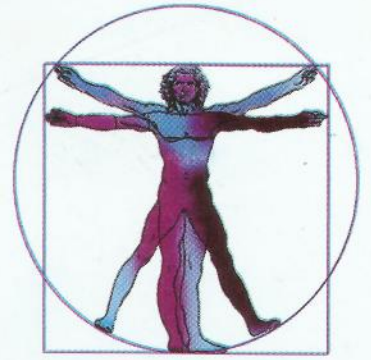


Anatomy of
Lower Limb
Summary & Illustrations



Scanned by
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Zaghloul

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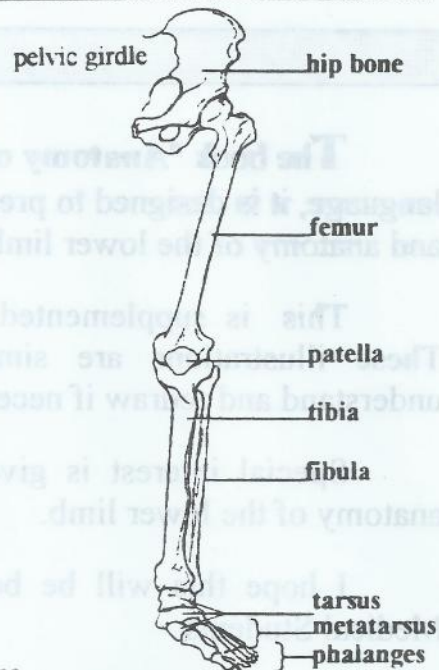
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BONES OF LOWER LIMB

• **The bones of the lower limb are as follows:**

1. The bone of the pelvic girdle: is the **hip bone**.
2. The bone of the thigh: is the **femur**.
3. The bones of the leg: are the **tibia** (medially), and **fibula** (laterally).
4. The bones of the foot: are **tarsus**, **metatarsus** and **phalanges**.



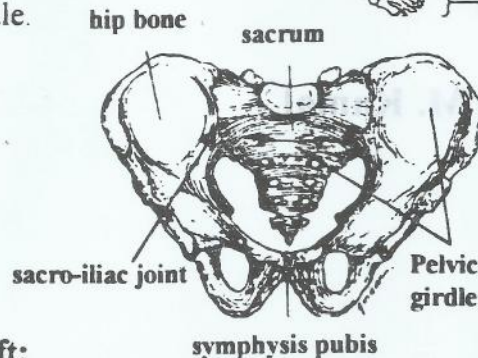
HIP BONE

It is a large irregular bone. The 2 hip bones and the sacrum constitute the pelvic girdle.

Articulations of the hip bone:

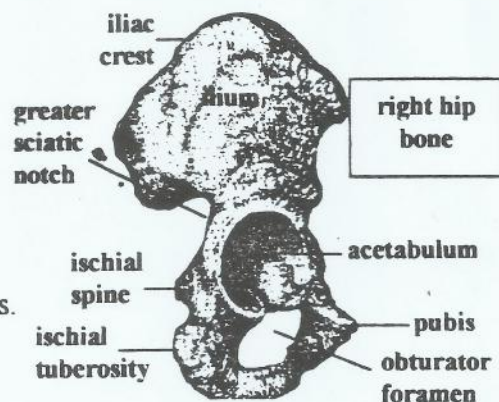
The hip bone forms the anterior and lateral walls of the bony pelvis. It has 2 articulations:

- **sacro-iliac joint** (synovial) and
- **symphysis pubis** (cartilaginous).



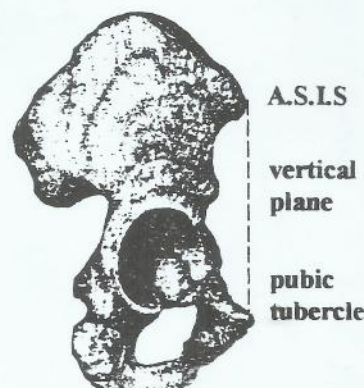
To identify the hip bone right or left:

1. **The acetabulum:** is directed laterally.
2. **The pubis and the obturator foramen:** are directed anteriorly (and downwards).
3. **The greater sciatic notch and the ischial spine** are directed posteriorly.
4. **The ilium and its curved border "iliac crest":** are directed upwards.
5. **The ischial tuberosity:** is directed downwards.

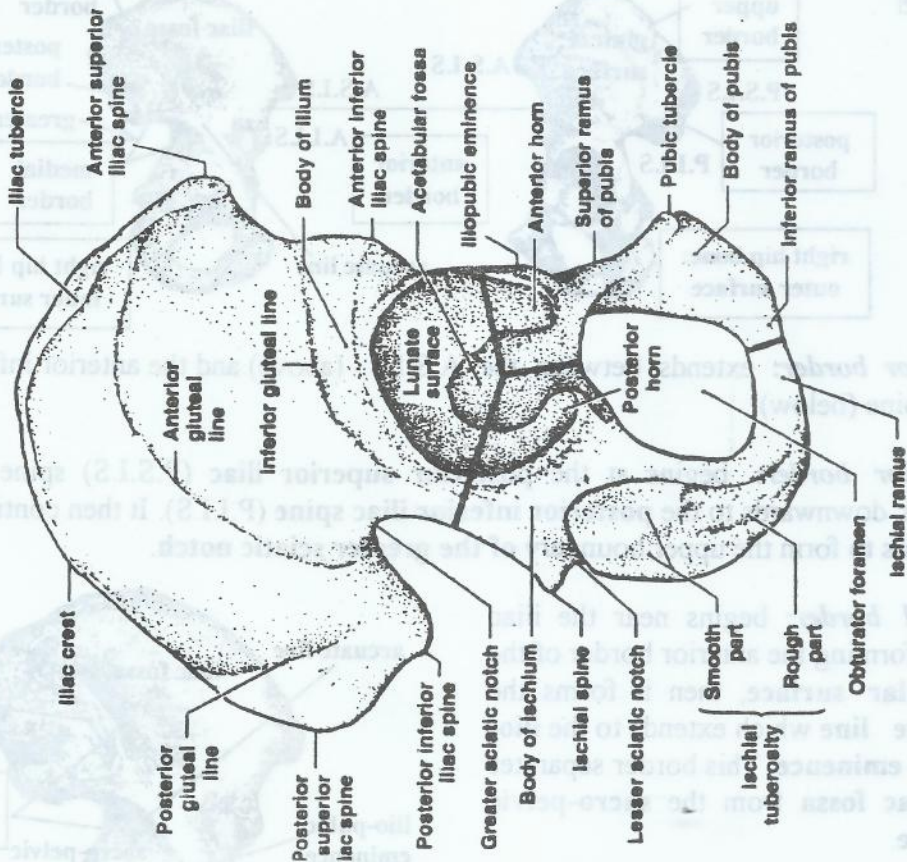


Anatomical position of the hip bone:

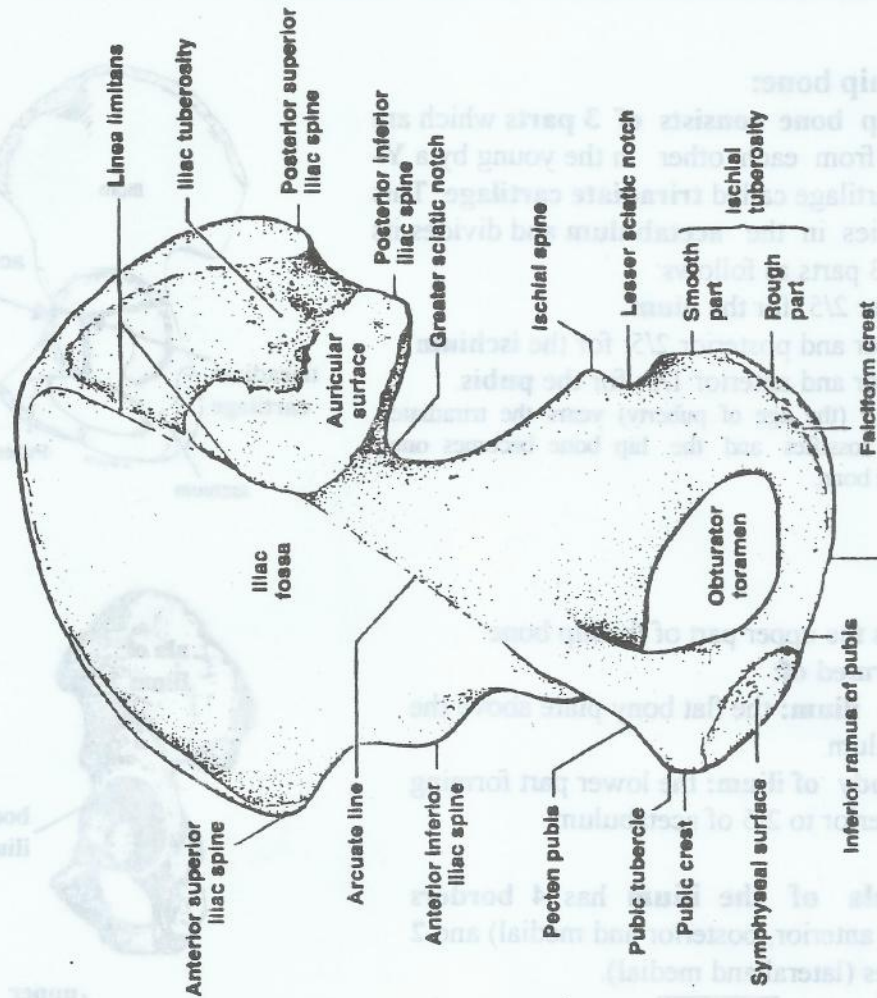
In the **anatomical position** the anterior superior iliac (A.S.I.S) & the **pubic tubercle** lie in the same **vertical plane**.



Hip bone - General features



Right hip bone - outer surface



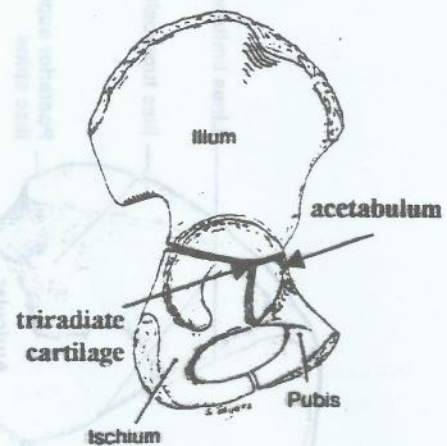
Right hip bone - inner surface

Parts of hip bone:

The hip bone consists of 3 parts which are separated from each other in the young by a Y-shaped cartilage called **triradiate cartilage**. This cartilage lies in the **acetabulum** and divides its floor into 3 parts as follows:

1. Upper 2/5: for the **ilium**.
2. Lower and posterior 2/5: for the **ischium**.
3. Lower and anterior 1/5: for the **pubis**.

N.B.: By 15 (the age of puberty) years the triradiate cartilage ossifies and the hip bone becomes one complete bone.



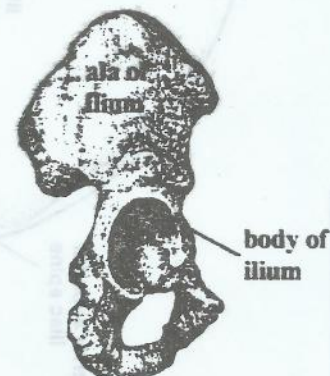
ILIUM

It forms the upper part of the hip bone

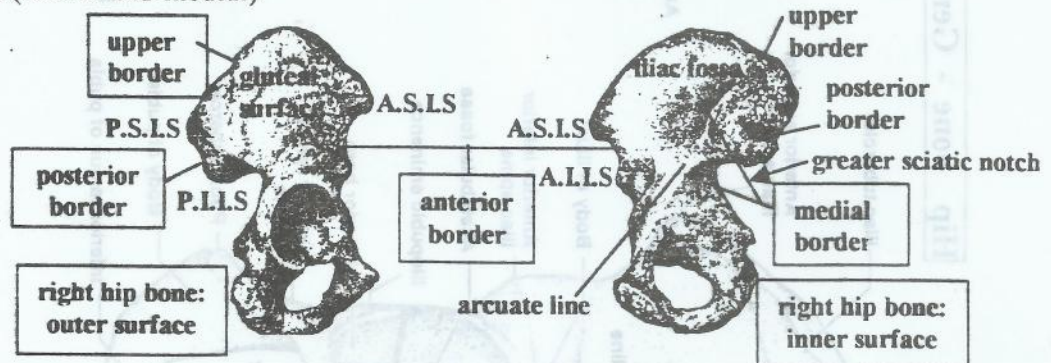
It is formed of:

- 1) **Ala of ilium**: the flat bony plate above the acetabulum.
- 2) **The body of ilium**: the lower part forming the superior 2/5 of acetabulum.

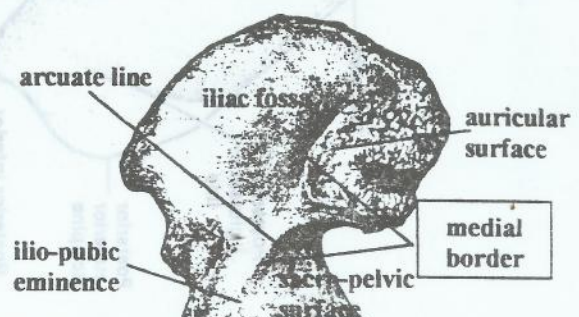
The **ala of the ilium** has 4 borders (upper, anterior, posterior and medial) and 2 surfaces (lateral and medial).



Borders:

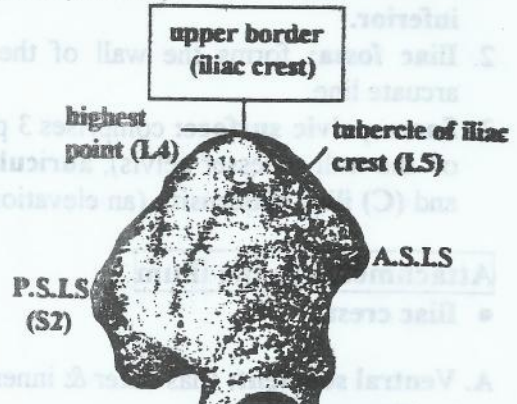


1. **Anterior border**: extends between the A.S.I.S. (above) and the anterior inferior iliac spine (below).
2. **Posterior border**: begins at the posterior superior iliac (P.S.I.S) spine and extends downwards to the posterior inferior iliac spine (P.I.I.S). It then continues forwards to form the upper boundary of the greater sciatic notch.
3. **Medial border**: begins near the iliac crest forming the anterior border of the **auricular surface**, then it forms the **arcuate line** which extends to the **ilio-pubic eminence**. This border separates the **iliac fossa** from the **sacro-pelvic surface**.



4. **Upper border:** is called the iliac crest.

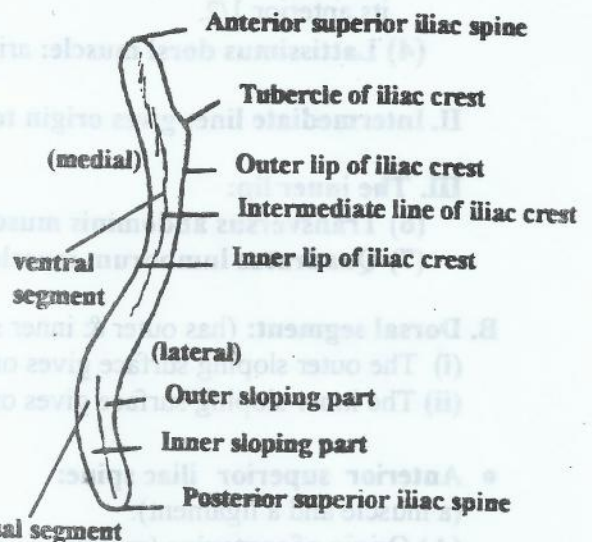
- It ends anteriorly as the **anterior superior iliac spine (A.S.I.S.)**, and ends posteriorly as the **posterior superior iliac spine (P.S.I.S.)**.
- About 5 cm behind the A.S.I.S., the outer lip of the iliac crest carries the **tubercle of iliac crest** which is a surface landmark situated opposite the spine of the 5th lumbar vertebra.
- The **highest point** of the iliac crest lies opposite the spine of the 4th lumbar vertebra.
- The **posterior superior iliac spine** lies on the level of the 2nd sacral spine; this level passes through the sacro-iliac joint.



• The upper border is divided into ventral and dorsal segments:

A. **The ventral segment:**

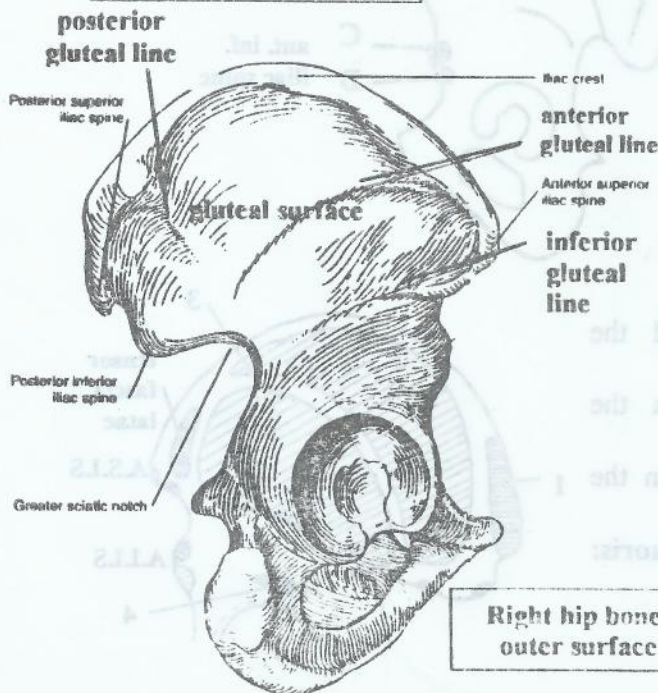
- It constitutes about 2/3 of the crest & is concave medially.
- It is formed of **outer & inner lips & intermediate rough line** in between.
- The **outer lip** carries the **tubercle of iliac crest** 5cm behind the A.S.I.S.



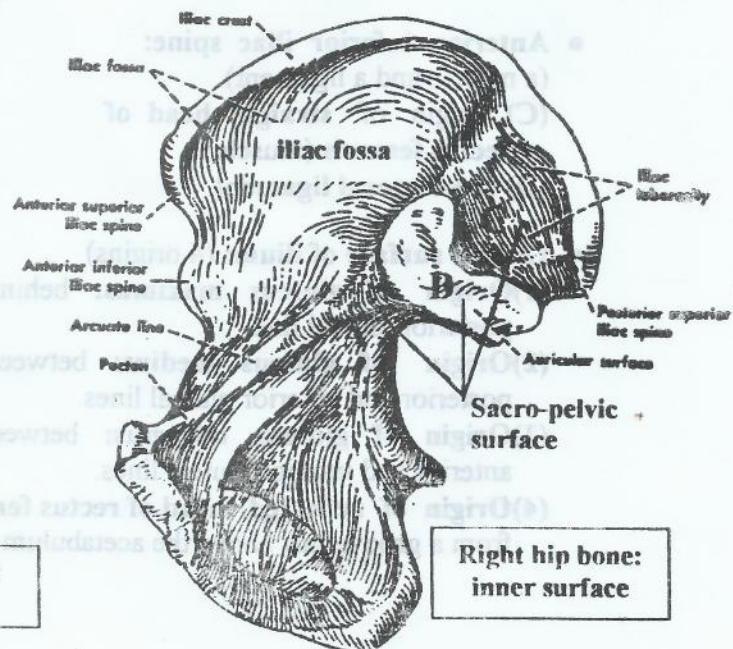
B. **The dorsal segment:**

- Constitutes the posterior 1/3 of the crest * is concave laterally.
- It is formed of **outer & inner sloping parts** separated by a ridge.

Surfaces of the ilium:



Right hip bone:
outer surface



Right hip bone:
inner surface

Surfaces of the ilium:

1. **Lateral (gluteal) surface:** shows 3 gluteal lines named **posterior, anterior and inferior**.
2. **Iliac fossa:** forms the wall of the greater pelvis, and is limited below by the arcuate line.
3. **Sacro-pelvic surface:** comprises 3 parts which are: **pelvic surface (A)** (forms part of the wall of lesser pelvis), **auricular surface (B)** (shares in the sacro-iliac joint), and **(C) iliac tuberosity** (an elevation behind the auricular surface).

Attachments to the ilium

- **Iliac crest:**

A. Ventral segment: (has outer & inner & intermediate line).

I. The outer lip:

- (1) **Tensor fascia latae muscle:** arises from its anterior part
- (2) **Ilio-tibial tract:** attached to the tubercle of iliac crest.
- (3) **External abdominal oblique muscle:** is inserted into its anterior 1/2.
- (4) **Lattissimus dorsi muscle:** arises from its posterior 1/2.

II. Intermediate line: gives origin to the **internal oblique muscle (5)**.

III. The inner lip:

- (6) **Transversus abdominis muscle** arises from its anterior 2/3rd.
- (7) **Quadratus lumborum muscle** arises from its posterior 1/3rd.

B. Dorsal segment: (has outer & inner sloping surface)

- (i) The outer sloping surface gives origin to **gluteus maximus muscle (8)**.
- (ii) The inner sloping surface gives origin to **sacrospinalis muscle (9)**.

- **Anterior superior iliac spine:**

(a muscle and a ligament):

- (A) Origin of **sartorius** (muscle).
- (B) **Inguinal ligament**.

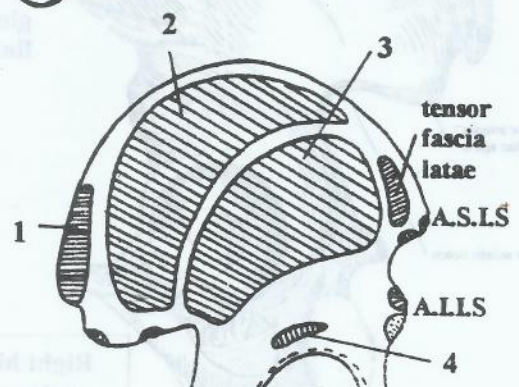
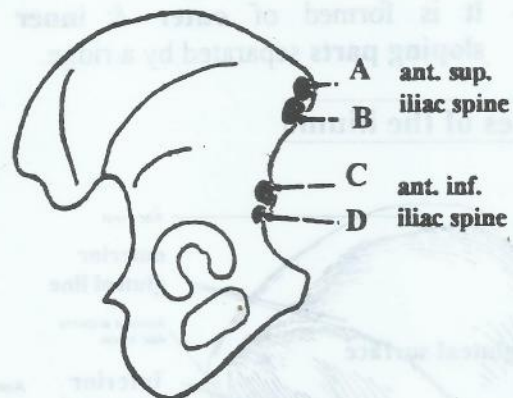
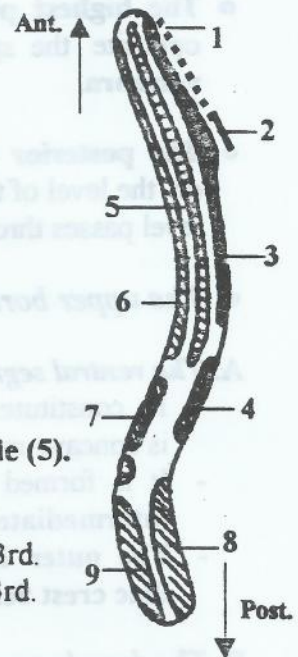
- **Anterior inferior iliac spine:**

(a muscle and a ligament).

- (C) Origin of **straight head of rectus femoris** (muscle).
- (D) **Ilio-femoral ligament**.

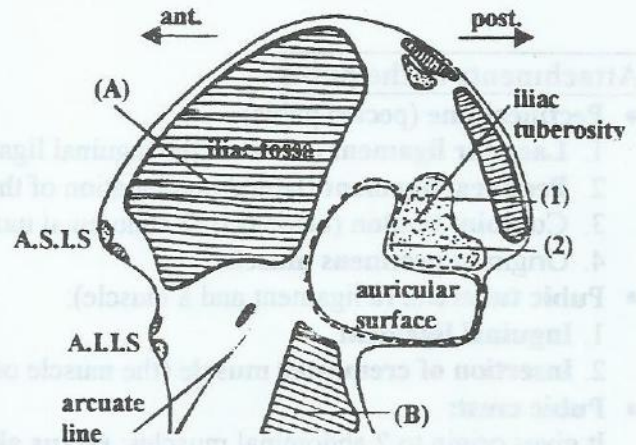
- **Gluteal surface of ilium:** (4 origins)

- (1) Origin of **gluteus maximus:** behind the posterior gluteal line.
- (2) Origin of **gluteus medius:** between the posterior and anterior gluteal lines.
- (3) Origin of **gluteus minimus:** between the anterior and inferior gluteal lines.
- (4) Origin of **reflected head of rectus femoris:** from a groove just above the acetabulum.

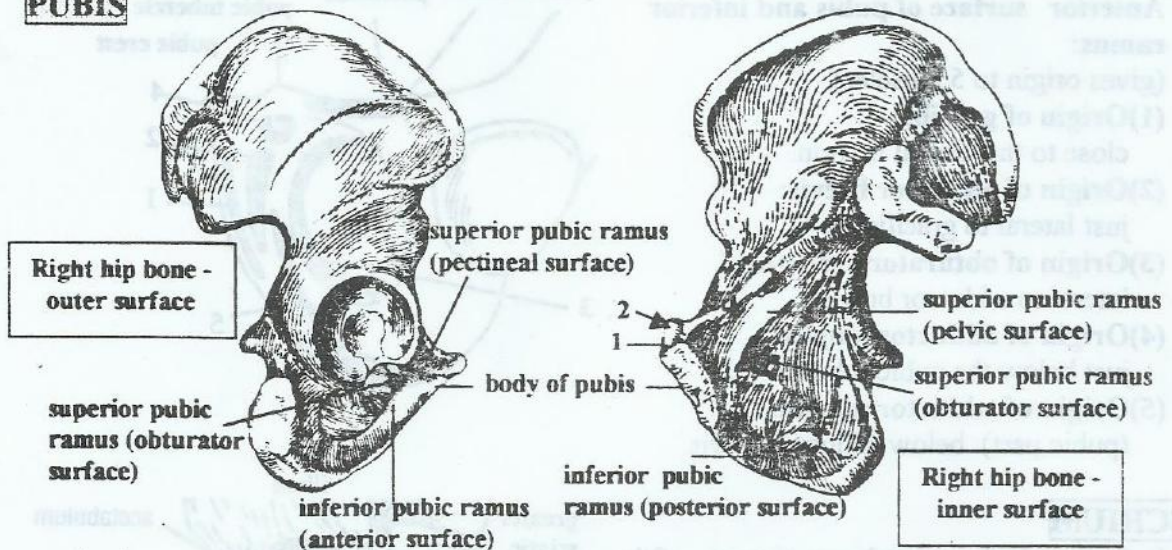


● **Medial surface of ilium:**

- **Iliac fossa:** gives origin to the iliacus (A).
- **Pelvic surface:** (below the arcuate line) gives origin to obturator internus (B).
- **Iliac tuberosity:** gives attachment to 2 ligaments:
(1) Interosseous ligament.
(2) Posterior sacro-iliac ligament.



PUBIS



The pubis forms the anterior and lower part of the hip bone.
It has a body and 2 rami (superior and inferior).

Body of pubis:

- Articulates with the body of the pubis of the opposite side at the **symphysis pubis** which is a cartilaginous joint.
- Its upper border is called the **pubic crest** (1) which ends laterally at the **pubic tubercle** (2).

Superior ramus of pubis:

- It joins the ilium at the **ilio-pubic eminence** (3), and forms the upper boundary of the obturator foramen.
Its upper border is sharp and is called the **pectineal line** (4) (**pecten pubis**).
- It has 3 surfaces:
 1. **Pectineal surface:** looks downwards and forwards (in the erect position).
 2. **Pelvic surface:** looks upwards and backward.
 3. **Obturator surface:** looks downwards and is marked by the obturator groove which transmits the obturator nerve and vessels.

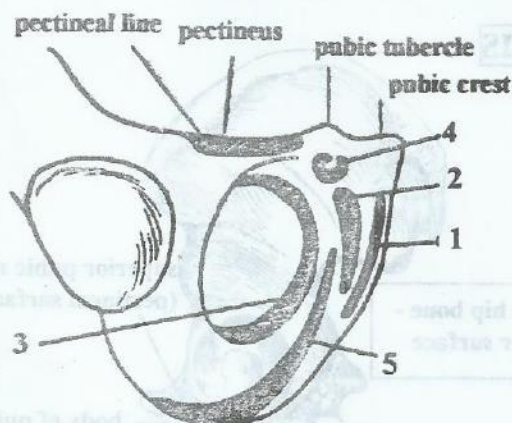
Inferior ramus of pubis:

It joins the ischial ramus to form the **side of the pubic arch**.
It has **anterior** and **posterior** surfaces.

Attachments to the pubis

- **Pectineal line** (pecten pubis):
 1. **Lacunar ligament** (a part of the inguinal ligament).
 2. **Pectineal ligament** (lateral continuation of the lacunar ligament).
 3. **Conjoint tendon** (belongs to 2 abdominal muscles).
 4. **Origin of pectineus muscle.**
- **Pubic tubercle:** (a ligament and a muscle):
 1. **Inguinal ligament.**
 2. **Insertion of cremaster muscle** (the muscle of the spermatic cord).
- **Pubic crest:**
It gives origin to 2 abdominal muscles: **rectus abdominis** and **pyramidalis**.
- **Anterior surface of pubis and inferior ramus:**
(gives origin to 5 muscles)
 - (1) **Origin of gracilis:**
close to the medial margin.
 - (2) **Origin of adductor brevis:**
just lateral to gracilis.
 - (3) **Origin of obturator externus:**
lateral to adductor brevis.
 - (4) **Origin of adductor longus:**
just below the pubic tubercle.
 - (5) **Origin of adductor magnus**
(pubic part): below adductor brevis.

Will be described in abdomen



ISCHIUM

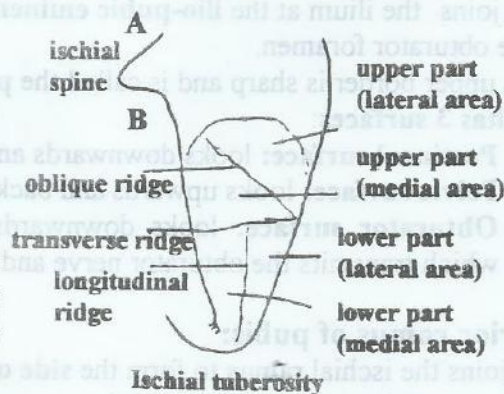
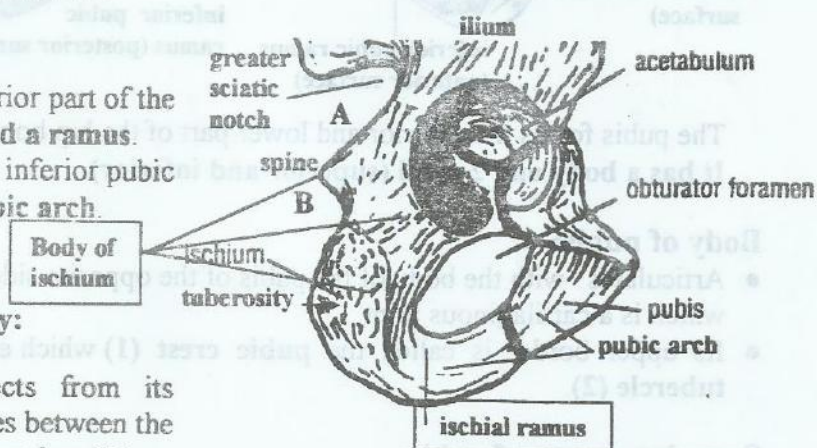
It forms the lower and posterior part of the hip bone. It comprises a **body** and a **ramus**.

The ischial ramus joins the inferior pubic ramus to form the side of the **pubic arch**.

Body of ischium:

It has a **spine** and a **tuberosity**:

- **The ischial spine:** projects from its posterior border and intervenes between the greater (A) and lesser sciatic notches (B).
- **The ischial tuberosity:** is a rough area on the posterior surface of the ischium. It is divided by a **transverse ridge** into upper and lower parts:
 - a. **Upper part:** quadrangular.
 - b. **Lower part:** triangular.
 (Remember: the ischial tuberosity has upper and lower parts each of which is divided into lateral and medial areas by means of oblique and longitudinal ridges).



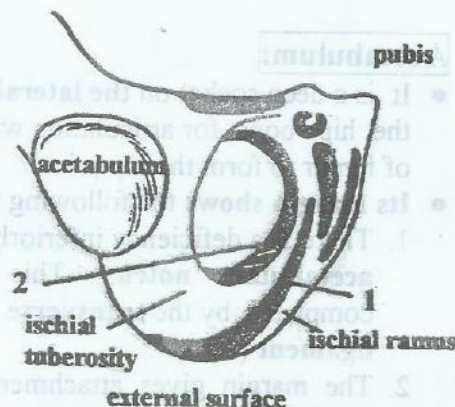
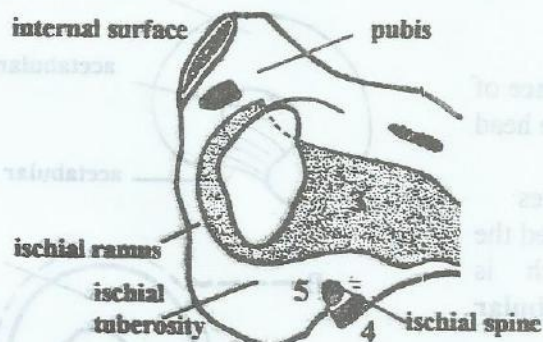
Attachments to the ischium

Ischial ramus:

1. **External surface:** gives origin to **adductor magnus muscle (1)** and **obturator externus muscle (2)**.

2. **Internal surface (pelvic area):** gives origin to **obturator internus muscle (3)**.

N.B.: The perineal area will be described in abdomen.

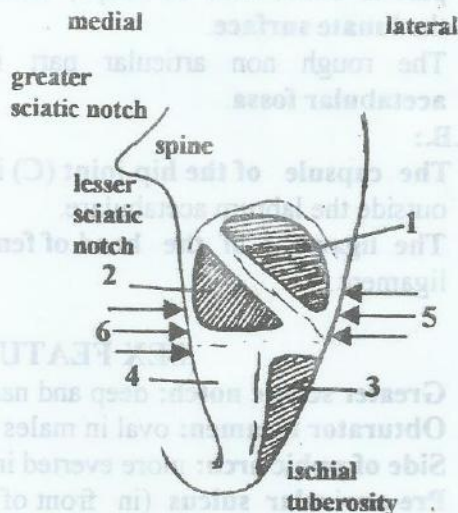


Ischial spine:

- It gives attachment to:
 1. **Sacro-spinous ligament (4)**.
 2. **Coccygeus muscle (5)**.
- Its back is related to the following:

Ischial tuberosity:

- Attachments to its surface:
 - (1) **Origin of semimembranosus:** from lateral area of the upper part.
 - (2) **Common origin of biceps and semitendinosus:** from medial area of the upper part.
 - (3) **Origin of ischial part of adductor magnus:** from lateral area of the lower part.
 - (4) **The medial area of the lower part is subcutaneous and supports the body in sitting.**
- Attachments to its margins:
 - (5) **Origin of quadratus femoris:** from the lateral margin.
 - (6) **Sacro-tuberous ligament:** to the medial margin.



Greater sciatic notch:

It transmits the following:

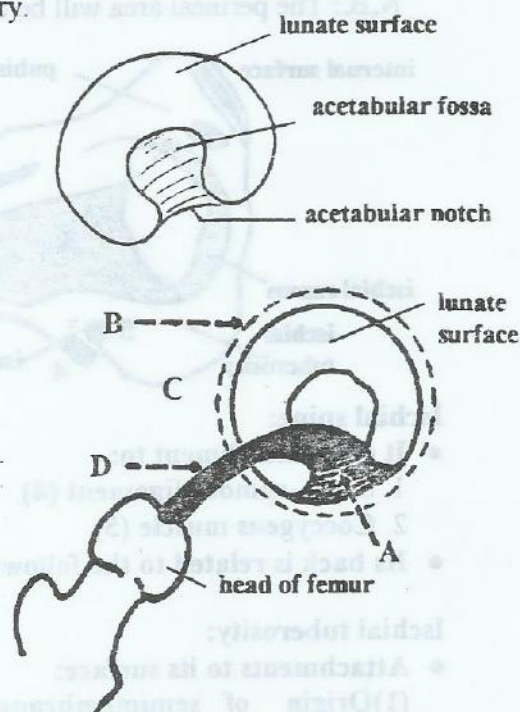
1. **Piriformis muscle.**
2. **Above the piriformis:** superior gluteal nerve and vessels.
3. **Below the piriformis:**
 - Inferior gluteal nerve and vessels.
 - Nerve to quadratus femoris.
 - The 3 structures which pass from the greater to the lesser sciatic foramen: internal pudendal artery, pudendal nerve and nerve to obturator internus.
 - Sciatic nerve.
 - Posterior cutaneous nerve of thigh.

Lesser sciatic notch:

- It transmits the following:
 1. Tendon of obturator internus.
 2. The 3 structures coming from the greater sciatic foramen: internal pudendal artery, pudendal nerve and nerve to obturator internus.
- It gives origin to the 2 gemelli: the superior gemellus from its upper boundary and the inferior gemellus from its lower boundary.

Acetabulum:

- It is a deep socket on the lateral surface of the hip bone, for articulation with the head of femur to form the hip joint.
- Its margin shows the following features:
 1. There is a deficiency inferiorly called the **acetabular notch**. This notch is completed by the **transverse acetabular ligament (A)**.
 2. The margin gives attachment to a rim of cartilage called **labrum acetabulare (B)**.
- Its floor is partly articular (i.e. smooth) and partly non-articular (rough). The articular part is **horse-shoe** in shape, and is called the **lunate surface**.
The rough non articular part is called **acetabular fossa**.

**N.B.:**

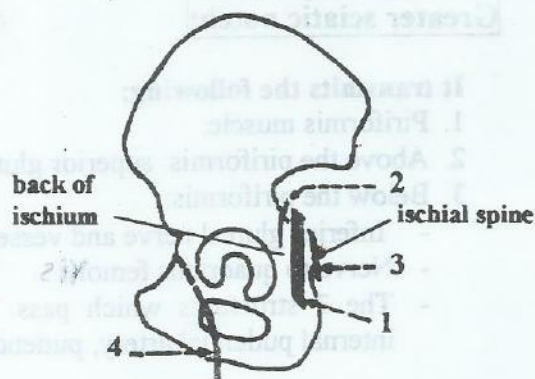
- i. The capsule of the hip joint (C) is attached to the margin of the acetabulum just outside the labrum acetabulare.
- ii. The ligament of the head of femur (D) connects it to the transverse acetabular ligament.

SEX FEATURES OF HIP BONE

1. **Greater sciatic notch:** deep and narrow in males but shallow and wide in females.
2. **Obturator foramen:** oval in males but triangular in females.
3. **Side of pubic arch:** more everted in males but less everted in females.
4. **Pre-auricular sulcus** (in front of the auricular surface): deep and always present in females but not present in males.
5. **Transverse diameter of acetabulum:** is smaller than the distance from the anterior margin of acetabulum to symphysis pubis in females. However, the 2 measurements are equal in males.

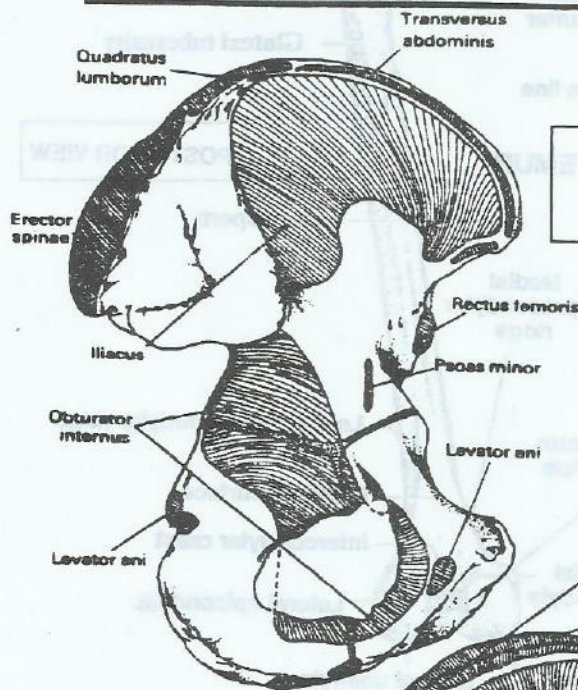
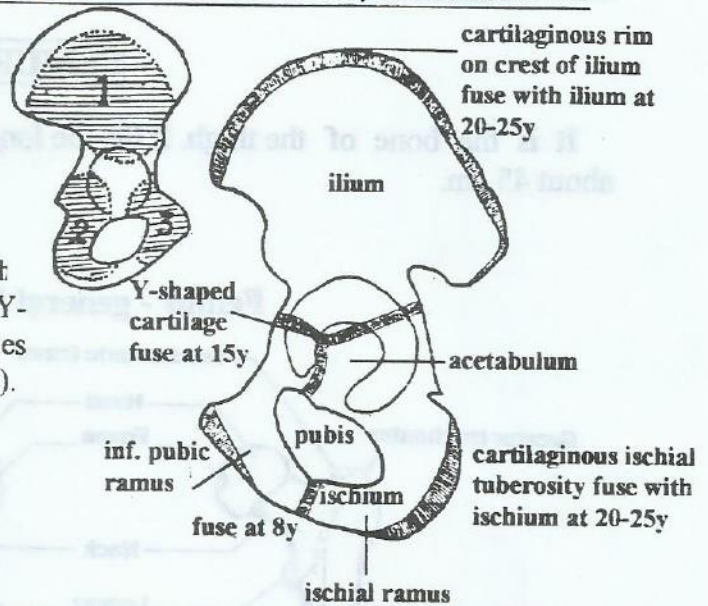
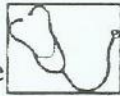
Nerves in direct contact with hip bone

- (1) **Sciatic nerve:** with the back of ischium.
- (2) **Nerve to quadratus femoris:** with the back of ischium.
- (3) **Nerve to obturator internus:** with the back of ischial spine.
- (4) **Obturator nerve:** in the obturator groove.



Ossification of hip bone

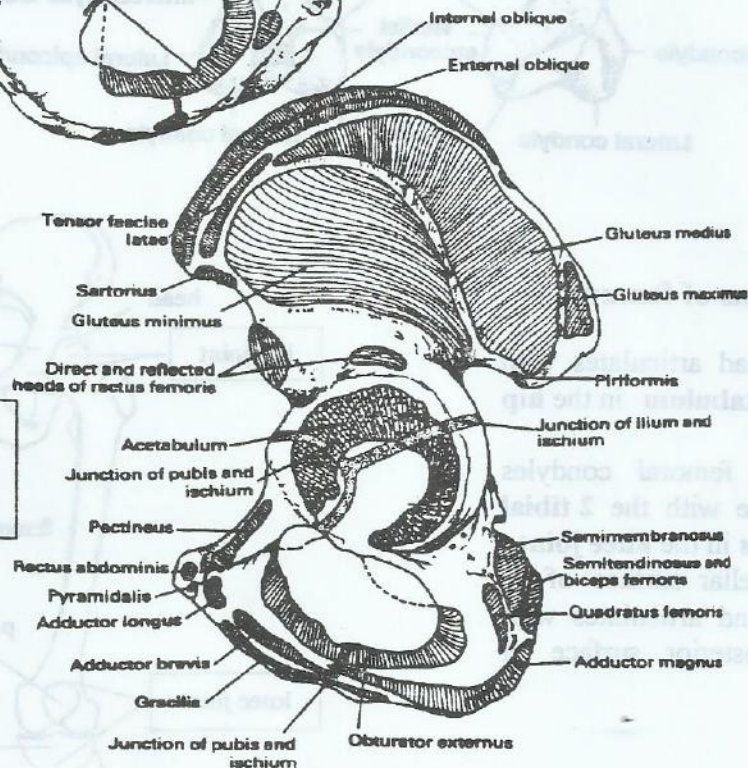
- 3 Primary centers appear during the 8th week: one center for each of the ilium(1), ischium(2) and pubis(3).
- The 3 primary centers meet in the acetabulum at the triradiate (Y-shaped) cartilage which becomes ossified by 15 years (age of puberty).
- The ischial ramus fuses with the inferior pubic ramus by 8 years.
- The bone grows from secondary centers which appear in the iliac crest and the ischial tuberosity.



PARTICULAR FEATURES OF HIP BONE

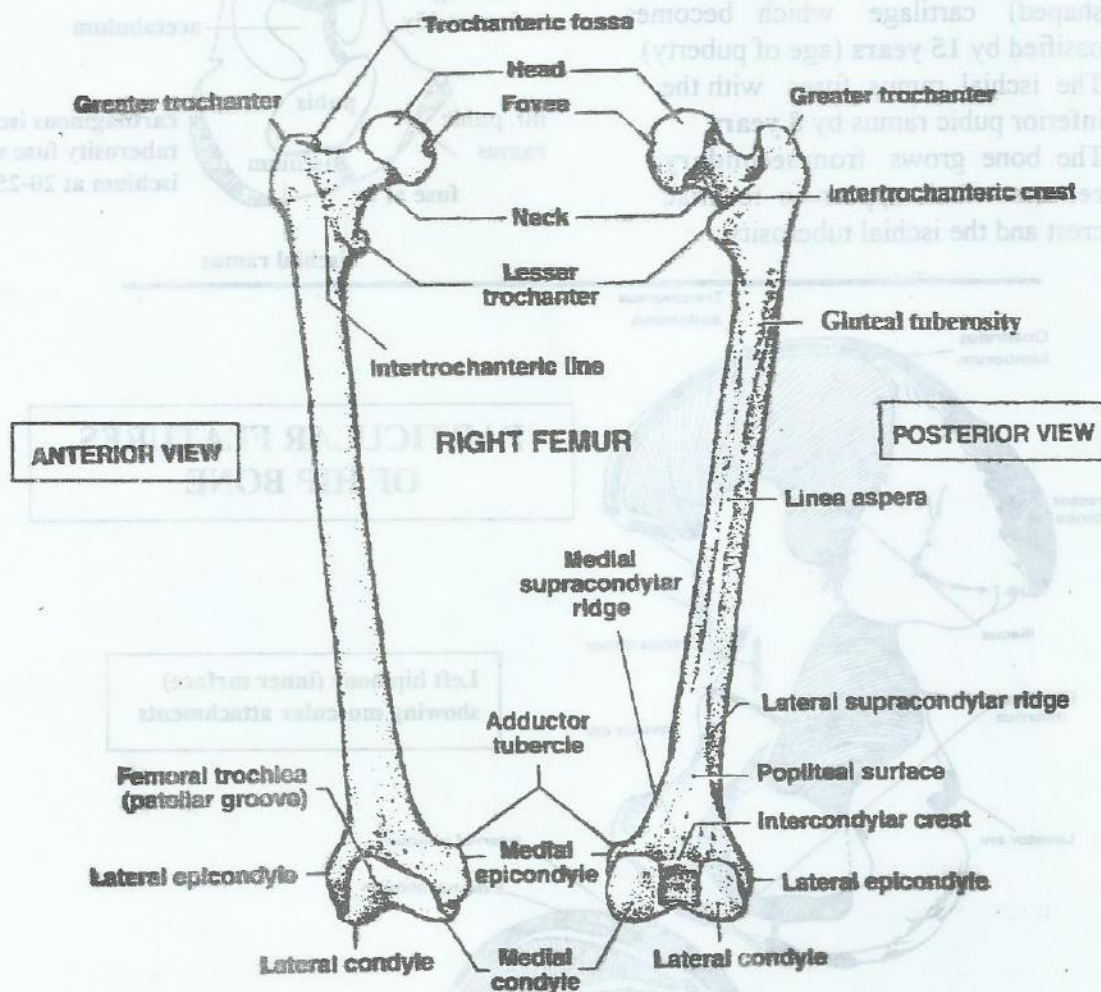
Left hip bone (inner surface)
showing muscular attachments

Left hip bone (outer surface)
showing muscular attachments

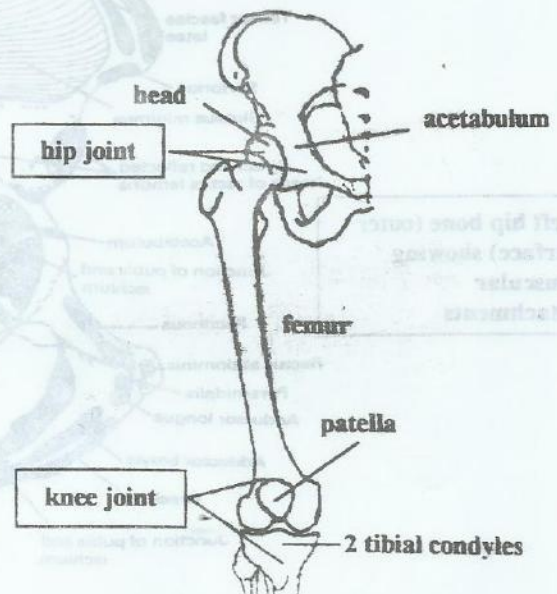


FEMUR

It is the bone of the thigh. It is the longest bone of the body its length is about 45 cm.

Femur - general features**Articulations of femur:**

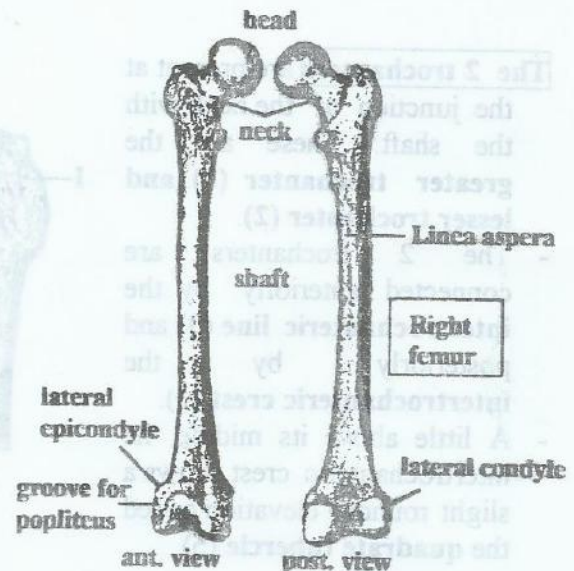
- (1) The head articulates with the acetabulum in the hip joint.
- (2) The 2 femoral condyles articulate with the 2 tibial condyles in the knee joint.
- (3) The patellar surface of the lower end articulates with the posterior surface of patella.



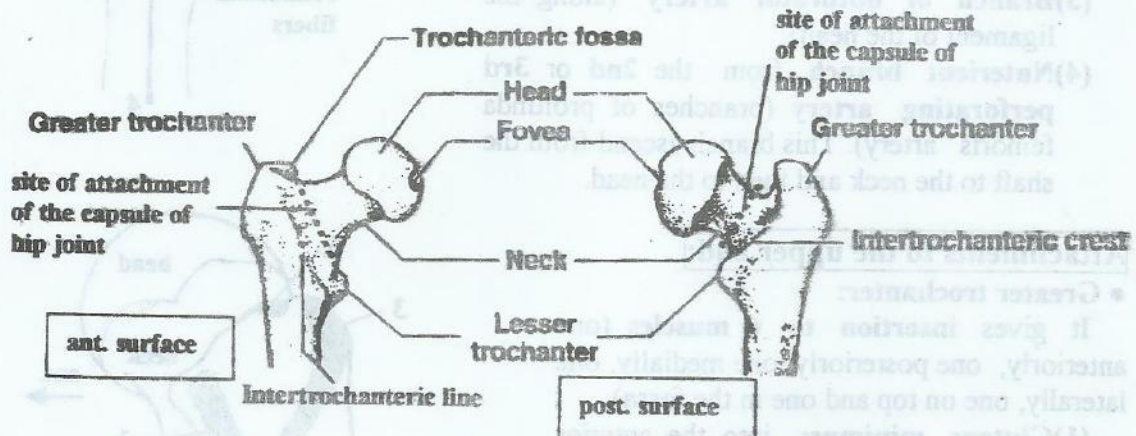
To identify the femur right of left:

1. The head and neck: form the upper end, and are directed medially.
2. The linea aspera: is directed posteriorly.
3. The shaft is convex forwards.
4. The 2 condyles: are more prominent posteriorly.

The lateral condyle is marked by the groove for popliteus just below the lateral epicondyle.

**The femur composed of: upper end - shaft - lower end.****Upper end:**

It is composed of head, neck and 2 trochanters (greater and lesser).

**Head:**

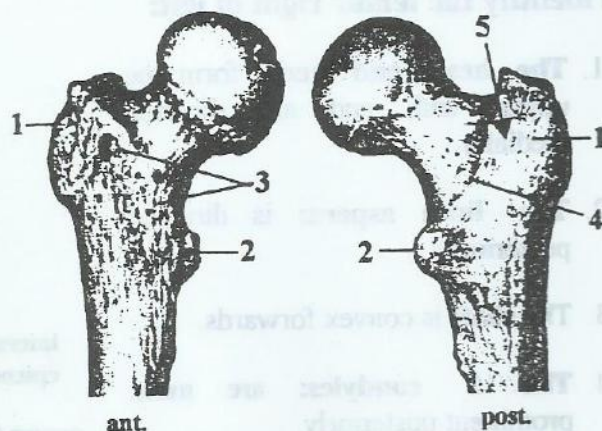
- It is directed upwards, forwards and medially.
- It forms more than 1/2 of a sphere and articulates with the acetabulum to form the hip joint.
- Near its center there is a fovea (pit) for the ligament of the head of femur. This ligament is attached by its other end to the transverse acetabular ligament and to the edges of acetabular notch.

Neck:

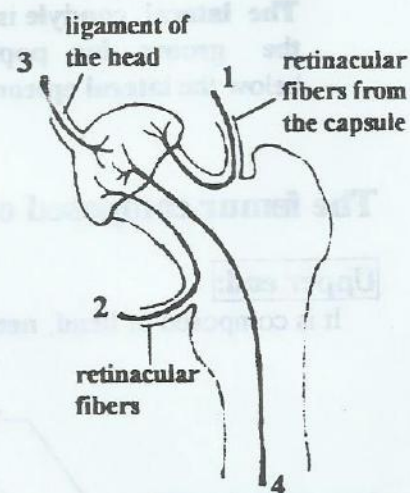
- It forms an angle of 125° with the shaft in the adult.
- The whole anterior surface of the neck lies inside the capsule of hip joint (intracapsular), but the lateral part of its posterior surface lies outside the capsule (extracapsular). Only the medial part of the posterior surface is intracapsular.

The 2 trochanters are present at the junction of the neck with the shaft. These are the **greater trochanter (1)** and **lesser trochanter (2)**.

- The 2 trochanters are connected anteriorly by the **intertrochanteric line (3)** and posteriorly by the **intertrochanteric crest (4)**.
- A little above its middle, the intertrochanteric crest shows a slight rounded elevation called the **quadrate tubercle (5)**.



- **Blood supply of the head:** from 4 arteries:
 - (1) Branch from medial circumflex femoral (along the neck).
 - (2) Branch from lateral circumflex femoral (along the neck).
 These arteries pierce the capsule and ascend to the neck and head along the retinacular fibers.
 - (3) Branch of obturator artery (along the ligament of the head).
 - (4) Nutrient branch from the 2nd or 3rd perforating artery (branches of profunda femoris artery). This branch ascends from the shaft to the neck and then to the head.



Attachments to the upper end:

• **Greater trochanter:**

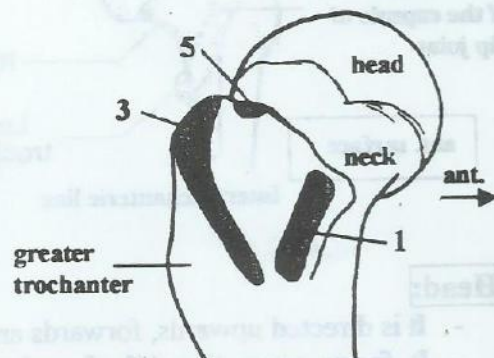
It gives insertion to 6 muscles (one anteriorly, one posteriorly, one medially, one laterally, one on top and one in the fossa).

- (1) **Gluteus minimus:** into the anterior surface.
- (2) **Quadratus femoris:** into the quadrate tubercle on its back.
- (3) **Gluteus medius:** into the lateral surface.
- (4) **Obturator internus:** into the medial surface.
- (5) **Piriformis:** into its top.
- (6) **Obturator externus:** into the trochanteric fossa.

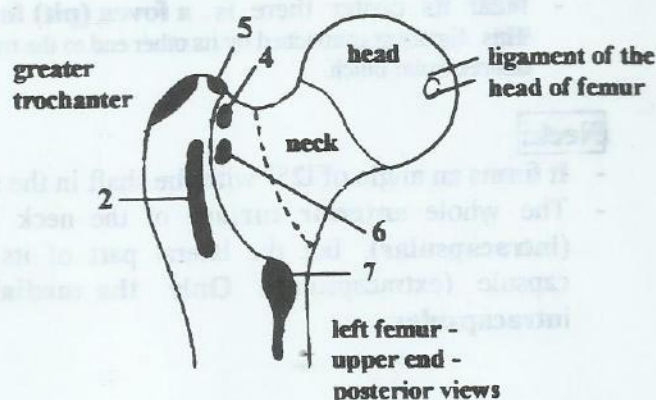
N.B. The 2 gemelli are inserted with the obturator internus.

• **Lesser trochanter:**

It gives insertion to only one muscle: iliopsoas (7).



right femur - upper end - anterolateral view



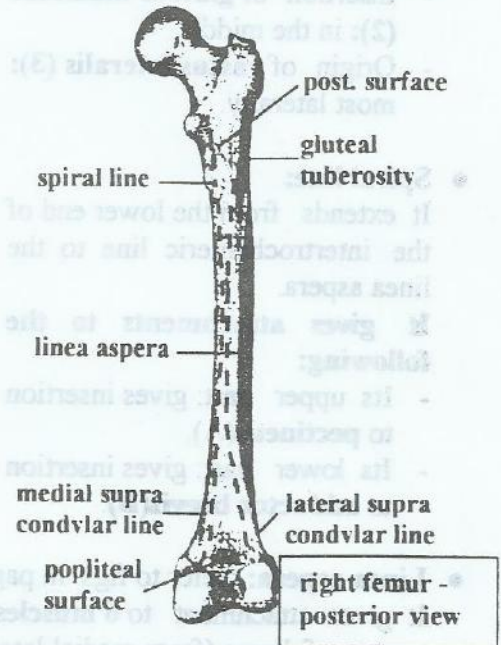
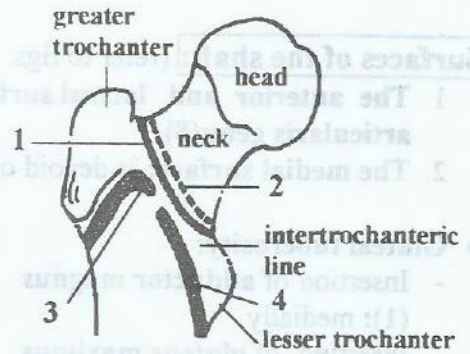
• Intertrochanteric line:

It gives attachment to the **ilio-femoral ligament (1)** and the **capsule of hip joint (2)**, in addition to part of the origin of **vastus lateralis (3)** and **vastus medialis (4)**.

Shaft:

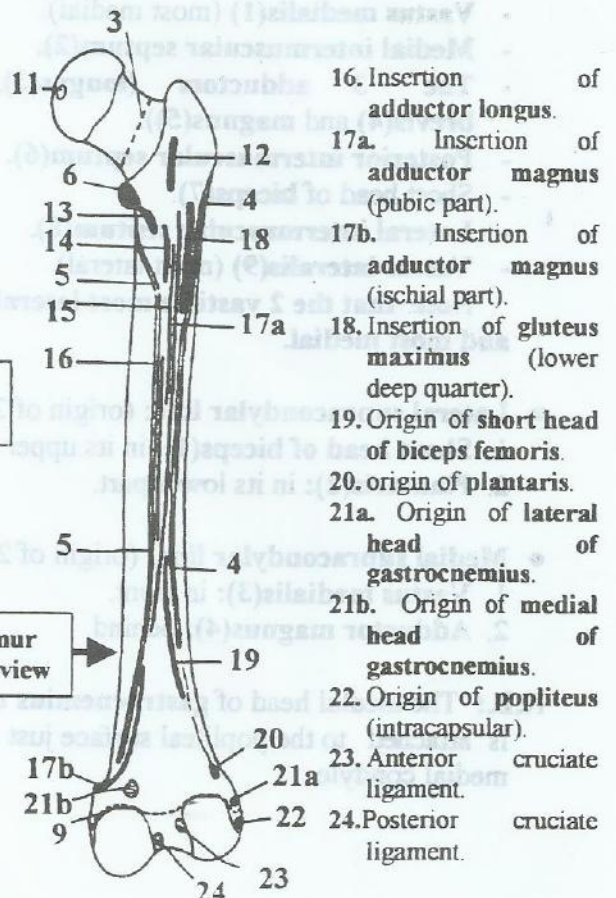
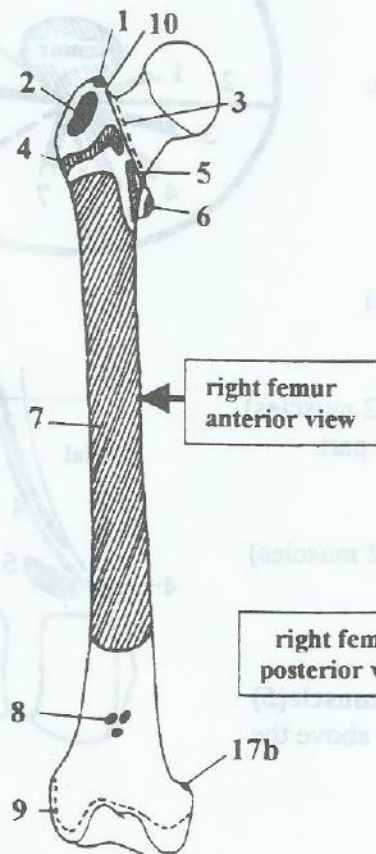
It is slightly convex forwards and is divided into 3 parts: upper 1/3, middle 1/3 and lower 1/3.

- Upper 1/3:** has 4 surfaces (anterior, posterior, medial, lateral). The posterior surface is bounded medially by the **spiral line** and laterally by the **gluteal tuberosity**.
- Middle 1/3:** has only 3 surfaces where the posterior surface is replaced by a prominent border called **linea aspera**.
- Lower 1/3:** has 4 surfaces with its posterior surface called **popliteal surface** and is bounded medially and laterally by the **medial and lateral supracondylar lines (ridges)** respectively.



Attachments to the shaft:

1. Insertion of **piriformis**
2. Insertion of **gluteus minimus**
3. Capsule of hip joint.
4. Origin of **vastus lateralis**.
5. Origin of **vastus medialis**.
6. Insertion of **psaos major**.
7. Origin of **vastus intermedius**.
8. Origin of **articularis genu**.
9. Capsule of knee joint.
10. **Ilio femoral ligament**.
11. ligament of the head of femur.
12. Insertion of **quadratus femoris**.
13. Insertion of **iliacus**.
14. Insertion of **pectineus**.
15. Insertion of **adductor brevis**.



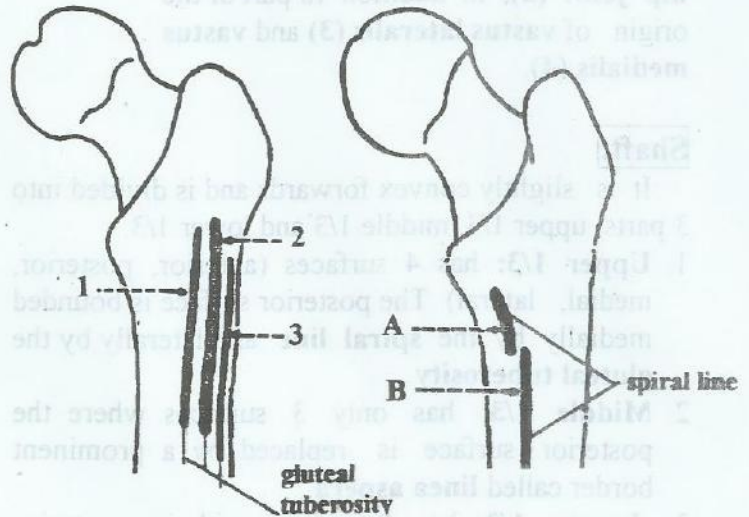
16. Insertion of **adductor longus**.
- 17a. Insertion of **adductor magnus (pubic part)**.
- 17b. Insertion of **adductor magnus (ischial part)**.
18. Insertion of **gluteus maximus (lower deep quarter)**.
19. Origin of **short head of biceps femoris**.
20. origin of **plantaris**.
- 21a. Origin of **lateral head of gastrocnemius**.
- 21b. Origin of **medial head of gastrocnemius**.
22. Origin of **popliteus (intracapsular)**.
23. **Anterior cruciate ligament**.
24. **Posterior cruciate ligament**.

Surfaces of the shaft: (refer to figs. in page 15).

1. **The anterior and lateral surfaces:** give origin to **vastus intermedius(7)** and **articularis genu(8)**.
2. **The medial surface:** is devoid of muscle attachment (hence smooth).

● **Gluteal tuberosity:**

- Insertion of **adductor magnus (1)**: medially.
- Insertion of **gluteus maximus (2)**: in the middle.
- Origin of **vastus lateralis (3)**: most laterally.

● **Spiral line:**

It extends from the lower end of the intertrochanteric line to the linea aspera.

It gives attachments to the following:

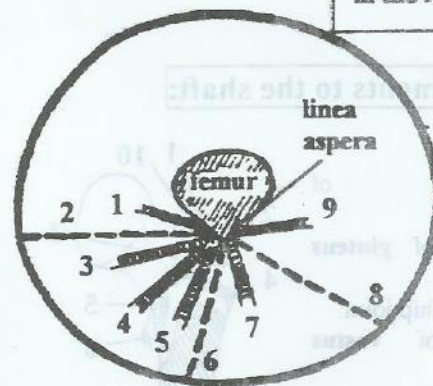
- Its upper part: gives insertion to **pectineus(A)**.
- Its lower part: gives insertion to **adductor brevis(B)**.

● **Linea aspera:** (refer to figs. in page 15 also).

It gives attachment to 6 muscles and 2 septa as follows (from medial lateral):

- **Vastus medialis(1)** (most medial).
- **Medial intermuscular septum(2)**.
- **The 3 adductors (longus(3), brevis(4) and magnus(5))**.
- **Posterior intermuscular septum(6)**.
- **Short head of biceps(7)**.
- **Lateral intermuscular septum(8)**.
- **Vastus lateralis(9)** (most lateral).

Note that the 2 vasti lie most lateral and most medial.



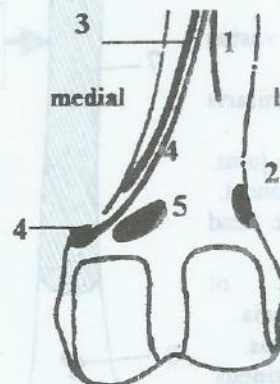
transverse section
in the right thigh

● **Lateral supracondylar line:** (origin of 2 muscles).

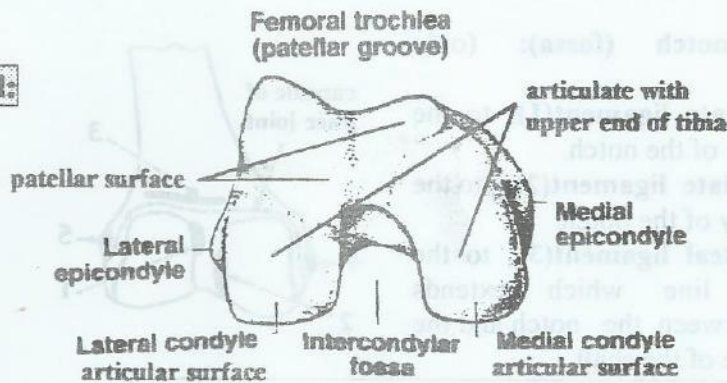
1. **Short head of biceps(1)**: in its upper part.
2. **Plantaris(2)**: in its lower part.

● **Medial supracondylar line:** (origin of 2 muscles)

1. **Vastus medialis(3)**: in front.
2. **Adductor magnus(4)**: behind.



N.B.: The medial head of **gastrocnemius muscle(5)** is attached to the popliteal surface just above the medial condyle

Lower end:

- It is expanded and consists of medial and lateral condyles which are separated from each other by the intercondylar notch or fossa.
- It articulates with 2 bones:
 1. **The patella:** articulates with the front of the 2 condyles but encroaching more on the lateral condyle.
 2. **The upper end of tibia:** articulates with the lower and posterior aspects of the 2 femoral condyles.

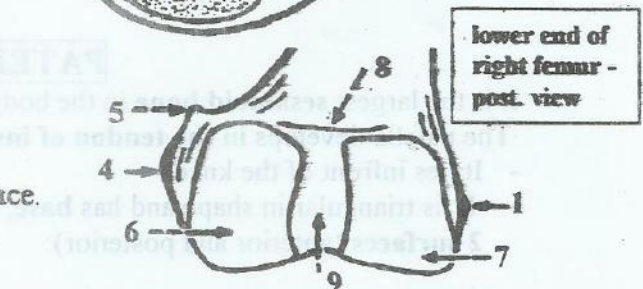
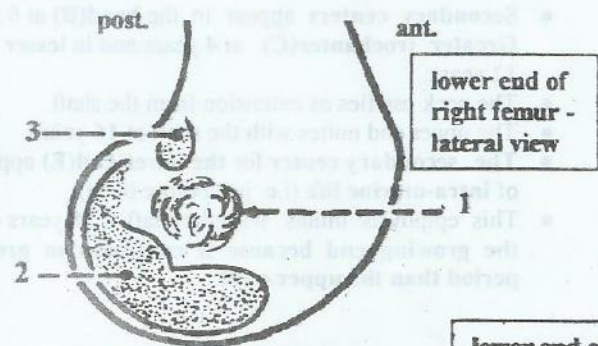
- **The lateral condyle:**

Lies more in line with the shaft and takes a greater share in transmission of body weight. It has 3 features:

- **Lateral epicondyle(1):** on its lateral surface.
- **Groove for popliteus muscle(2):** below and behind the lateral epicondyle.
- **Impression for lateral head of gastrocnemius(3).**

- **The medial condyle:** has 2 features:

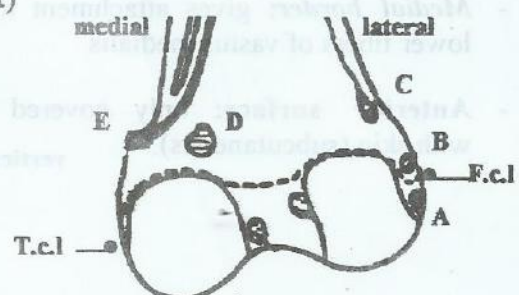
- **Medial epicondyle(4):** on its medial surface.
- **Adductor tubercle(5):** at the lower end of the medial supracondylar line.



N.B.: 6 = medial condyle - 7 = lateral condyle -
8 = intercondylar line - 9 = intercondylar fossa.

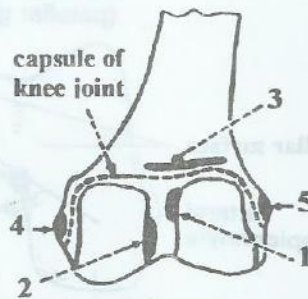
Attachments to the lower end:

- **Lateral condyle:** (3 muscles and one ligament)
 1. **Origin of popliteus(A):** from the anterior end of the groove for popliteus (just below the lateral epicondyle)
 2. **Origin of lateral head of gastrocnemius(B):** just above and behind the lateral epicondyle.
 3. **Origin of plantaris(C):** from the popliteal surface just above the lateral condyle.
 4. **Fibular collateral ligament (F.c.l):** from the lateral epicondyle.
- **Medial condyle:** (2 muscles and one ligament)
 1. **Origin of medial head of gastrocnemius(D):** from the popliteal surface just above the medial condyle.
 2. **Insertion of adductor magnus(E):** into the adductor tubercle.
 3. **Tibial collateral ligament (T.c.l):** from the medial epicondyle.



● **Intercondylar notch (fossa):** (only ligaments)

- **Anterior cruciate ligament(1):** to the lateral boundary of the notch.
- **Posterior cruciate ligament(2):** to the medial boundary of the notch.
- **Oblique popliteal ligament(3):** to the intercondylar line which extends transversely between the notch and the popliteal surface of the shaft.

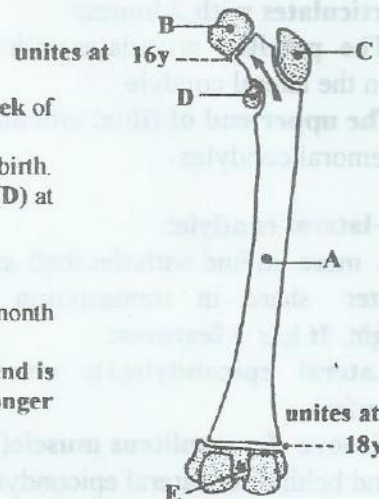


N.B.: - Tibial collateral ligament(4): is attached medial epicondyle.
- Fibular collateral ligament(5): is attached the lateral epicondyle.

Ossification of the femur:



- One primary center(A) for the shaft appears at the 8th week of intra-uterine life.
- Secondary centers appear in the head(B) at 6 month after birth. Greater trochanter(C) at 4 years and in lesser trochanter(D) at 12 years.
- The neck ossifies as extension from the shaft.
- The upper end unites with the shaft at 16 years.
- The secondary center for the lower end(E) appears at 9th month of intra-uterine life (i.e. just before birth).
- This epiphysis unites with the shaft at 18 years (the lower end is the growing end because it continues to grow for a longer period than the upper end).



PATELLA

- It is the largest sesamoid bone in the body.

The patella develops in the tendon of insertion of the quadriceps femoris

- It lies in front of the knee.
- It is triangular in shape and has base, apex, 2 borders (medial and lateral) and 2 surfaces (anterior and posterior):

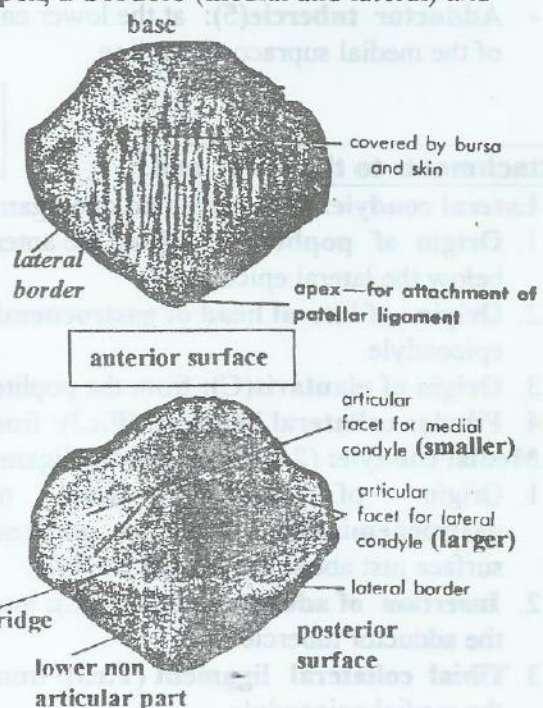
- **Base:** directed upwards, and gives insertion to the quadriceps femoris muscle.

- **Apex:** directed downwards, and gives attachment to the ligamentum patellae (patellar ligament).

- **Lateral border:** gives attachment to lower fibers of vastus lateralis.

- **Medial border:** gives attachment to lower fibers of vastus medialis.

- **Anterior surface:** only covered with skin (subcutaneous).



- **Posterior surface:** is divided into an **upper articular part** and a **lower non-articular part**.
- The articular part is subdivided by a vertical ridge into a large **lateral area** and a smaller **medial area**.
- These 2 areas articulate with the front of the 2 **femoral condyles**.

To identify the patella right or left:

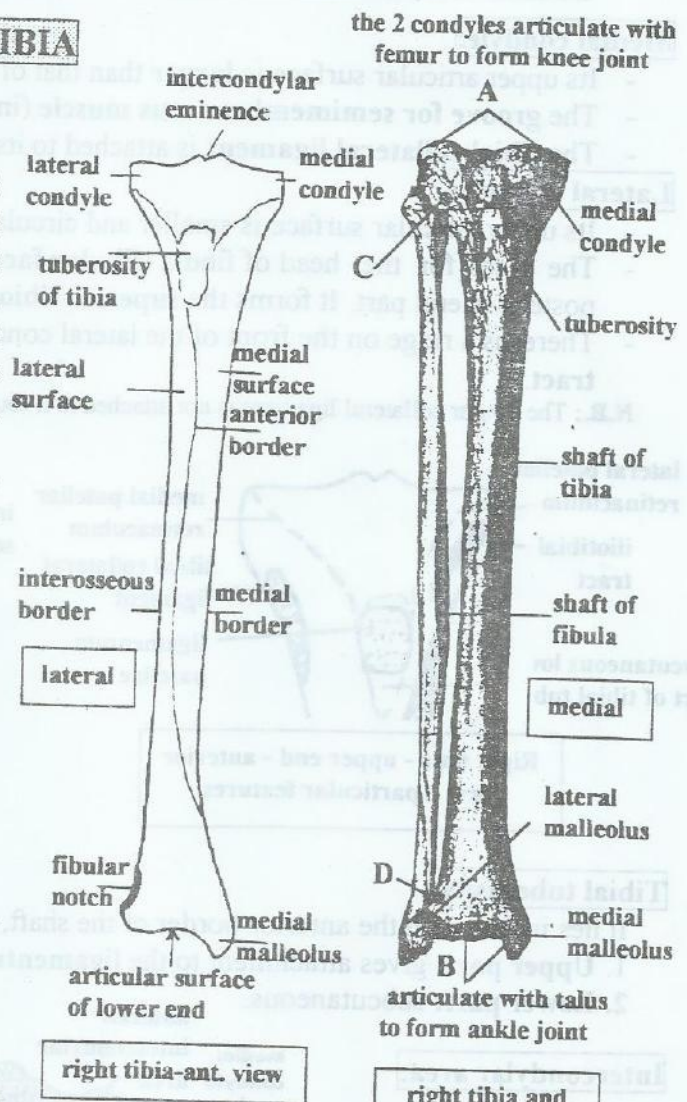
1. The **base** is directed upwards & **apex** downwards.
2. **Anterior surface** is rough, the **posterior surface** is showing 2 articular facets.
3. The **lateral articular facet** is larger than the medial one.

It is the **medial bone** of the leg

Articulations:

1. The superior surface of its 2 condyles (medial lateral tibial condyles) articulate with 2 condyles of femur (**knee joint**)(A).
2. The inferior surface of the lower end, and the lateral surface of the medial malleolus articulate with the talus (**ankle joint**)(B).
3. The fibular facet on the back of the lateral condyle articulate with the head of fibula in the **superior tibiofibular joint**(C) (synovial).
4. The fibular notch of the lower end articulate with the rough area found on the lower most medial part of the shaft of fibula in the **inferior tibiofibular joint**(D) (fibrous).

TIBIA



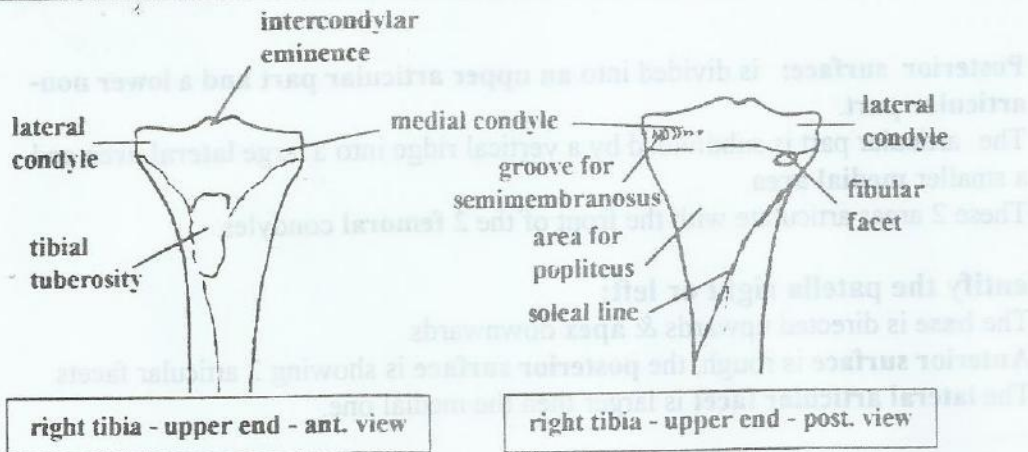
To identify the tibia right or left:

1. The 2 **condyles**: form the upper end.
2. The **tibial tuberosity**: anteriorly.
3. The **medial malleolus**: medially.
4. The **fibular notch**: laterally.

- The tibia has **upper end, shaft, and lower end**.

Upper end:

- It is the larger end, and is composed of 2 **condyles** (medial and lateral).
- The upper surfaces of the 2 condyles are separated from each other by a non-articular area called the **intercondylar area**.
- The middle of intercondylar area is elevated to form the **intercondylar eminence**.
- The **tibial tuberosity** lies on the front of the upper end at its junction with shaft.

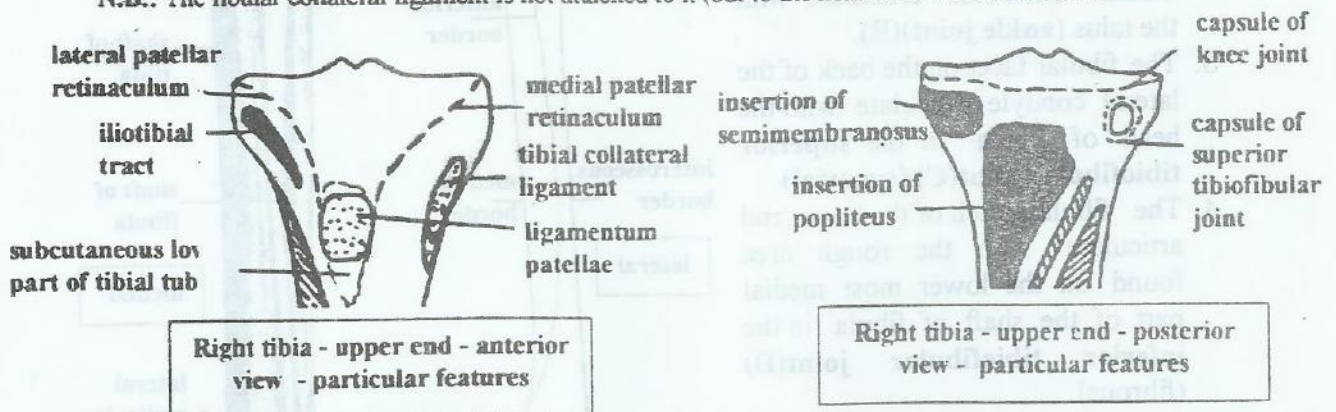
**Medial condyle:**

- Its upper articular surface is **larger** than that of the lateral condyle.
- The **groove for semimembranosus muscle** (insertion) lies on its back.
- The **tibial collateral ligament** is attached to its medial side.

Lateral condyle:

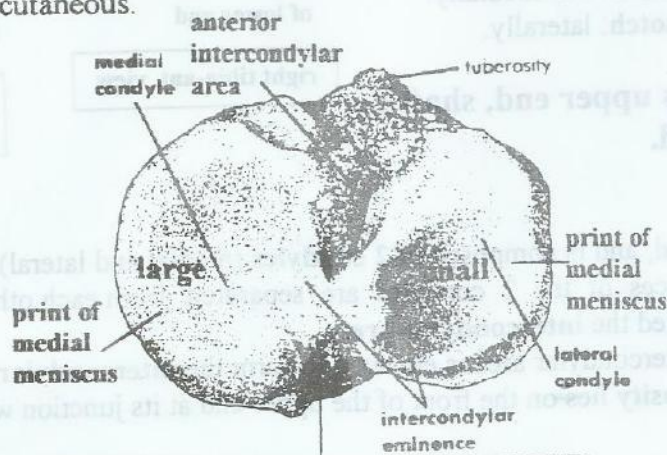
- Its upper articular surface is smaller and circular in shape.
- The facet for the head of fibula (**fibular facet**) lies on the under surface of its postero-lateral part. It forms the **superior tibiofibular joint**.
- There is a ridge on the front of the lateral condyle gives attachment to **iliotibial tract**.

N.B.: The fibular collateral ligament is not attached to it (but to the head of the fibula instead).

**Tibial tuberosity:**

It lies in line with the anterior border of the shaft, and consists of 2 parts:

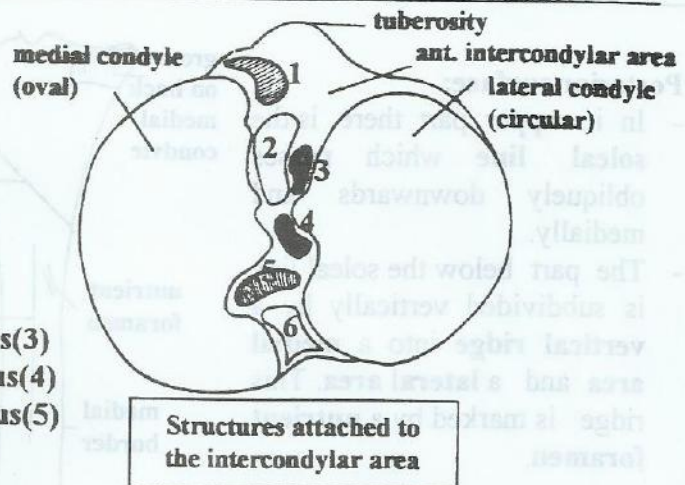
1. **Upper part:** gives attachment to the **ligamentum patellae**.
2. **Lower part:** subcutaneous.

Intercondylar area:

Superior surface of upper end of right tibia

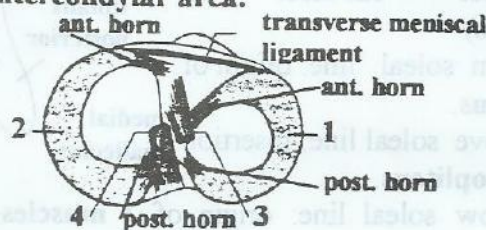
The intercondylar area gives attachment to the following 6 structures as follows from before backwards:

- Anterior horn of medial meniscus(1)
- Anterior cruciate ligament(2)
- Anterior horn of lateral meniscus(3)
- Posterior horn of lateral meniscus(4)
- Posterior horn of medial meniscus(5)
- Posterior cruciate ligament(6)



To understand the arrangement on the intercondylar area:

- Lateral meniscus(1): being circular, its 2 horns are attached close together in the middle of the area.
- Medial meniscus(2): being oval, its posterior horn is just posterior to the lateral meniscus but its anterior horn is placed far anteriorly separated from the lateral meniscus by the anterior cruciate ligament(3).
- The posterior cruciate ligament(4): is known to be the most posterior structure and has a separate depression for itself.

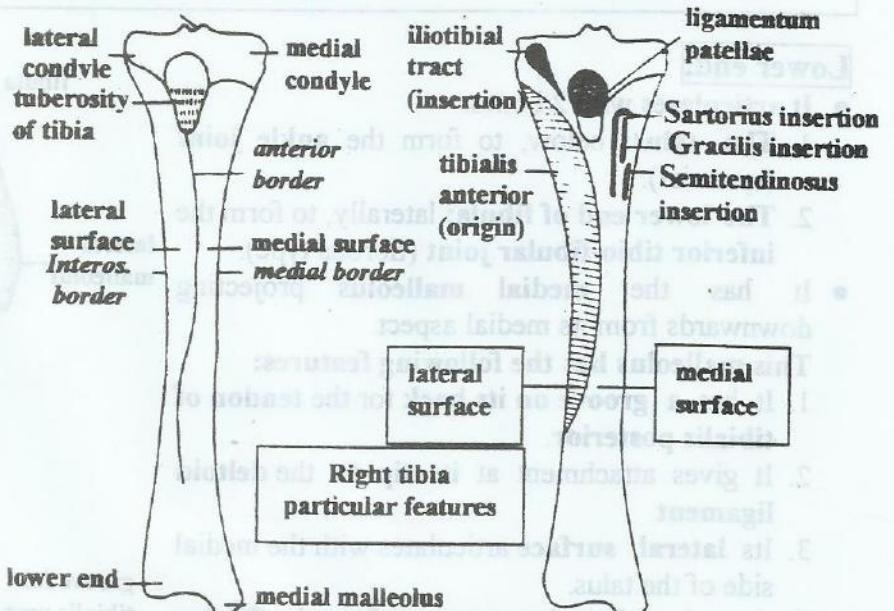


Shaft:

It has 3 borders (*anterior, medial and interosseous*) and 3 surfaces (*medial, lateral and posterior*).

Borders:

- The *anterior border (shin)*: is sharp, curved & subcutaneous.
- The *medial border*: extends downward to the back of medial malleolus.
- The *interosseous (lateral) border*: gives attachment to the interosseous tibio-fibular membrane.



Surfaces:

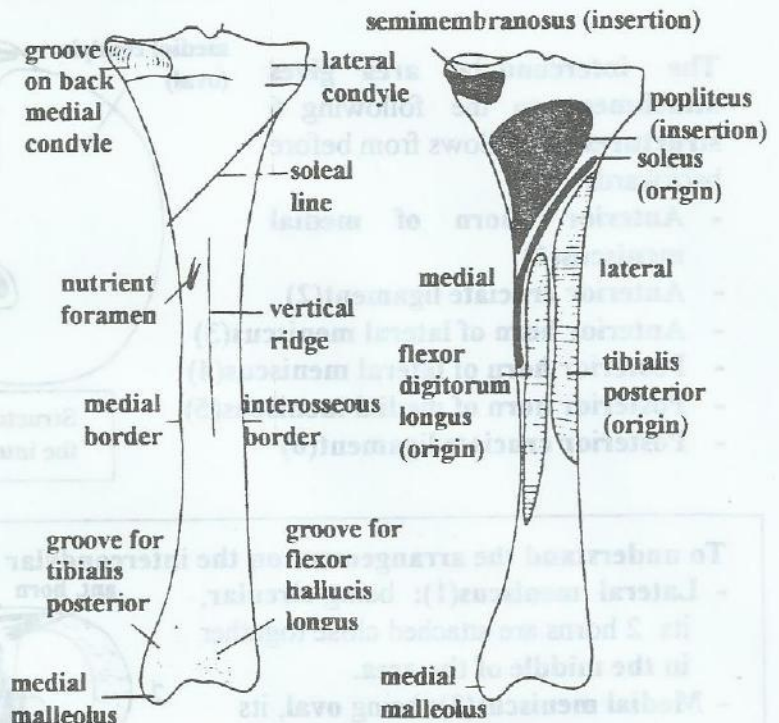
- **Medial surface:**
 - It is subcutaneous.
 - Its uppermost part gives attachment to 3 structures (insertions of 3 muscles (S.G.S)) as follows from before backwards:
 1. Sartorius (S)
 2. Gracilis (G)
 3. Semitendinosus (S)
- **Lateral surface:**
 - It gives origin to the tibialis anterior: from its upper 3/4 (or 2/3).

• **Posterior surface:**

- In its upper part there is the **soleal line** which passes obliquely downwards and medially.
- The part below the soleal line is subdivided vertically by a **vertical ridge** into a **medial area** and a **lateral area**. This ridge is marked by a **nutrient foramen**.

- **Muscles attached to the posterior surface:** (4 muscles)

1. From soleal line: origin of **soleus**.
2. Above soleal line: insertion of **popliteus**.
3. Below soleal line: origin of 2 muscles - **tibialis posterior** (lateral to the vertical ridge) and **flexor digitorum longus** (medial to the vertical ridge).



Remember that the shaft of tibia has 8 muscles attached to it.

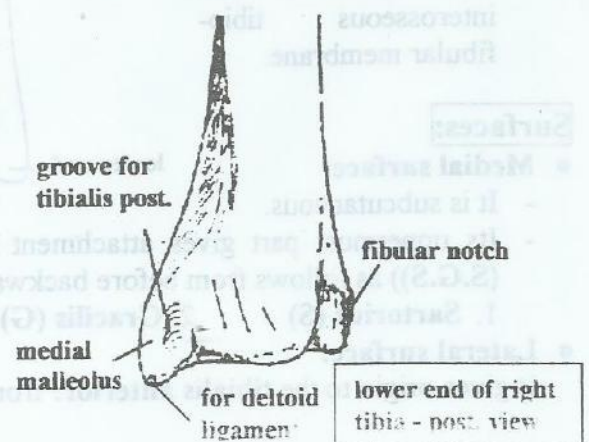
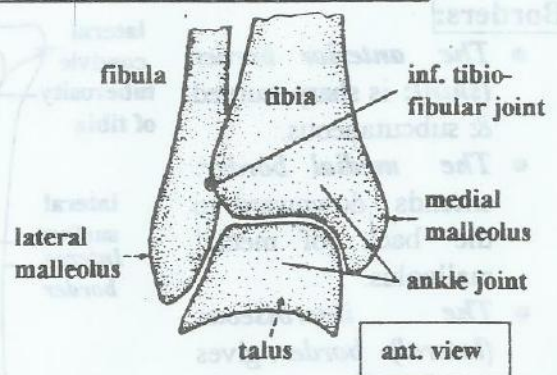
- A. 4 **Insertions** (near the upper end): sartorius, gracilis, semitendinosus and popliteus.
- B. 4 **Origins** (lower down): tibialis anterior, tibialis posterior, soleus and flexor digitorum longus.

Lower end:

- It articulates with 2 bones:
 1. **The talus:** below, to form the **ankle joint** (synovial).
 2. **The lower end of fibula:** laterally, to form the **inferior tibio-fibular joint** (fibrous type).
- It has the **medial malleolus** projecting downwards from its medial aspect.

This malleolus has the following features:

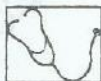
1. It has a **groove on its back** for the tendon of **tibialis posterior**.
 2. It gives attachment at its tip to the **deltoid ligament**.
 3. Its **lateral surface** articulates with the medial side of the talus.
- Its lateral surface is concave to form the **fibular notch** for articulation with the lower end of the fibula to form the **inferior tibio-fibular joint** which is fibrous.
- (note that the superior tibio-fibular joint is synovial).



- The anterior surface of the lower end is smooth and continuous above with the lateral surface of the shaft.
- It is crossed by the structures which pass deep to the superior extensor retinaculum.

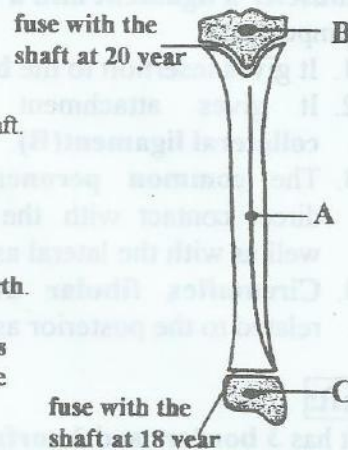
Subcutaneous parts of tibia:

- The 2 condyles.
- Tibial tuberosity.
- Anterior border of the shaft.
- Medial surface of the shaft.
- Medial malleolus.



Ossification of the tibia:

- A primary center for the shaft(A) appears at the 8 week.
- A secondary center appears in the upper end(B) immediately after birth.
- A secondary center appear in the lower end(C) in the first year.
- The upper end is the growing end as it fuses with the shaft at 20 years while the lower end fuses at 18 years (the region of the knee is the growing region of the lower limb).



FIBULA

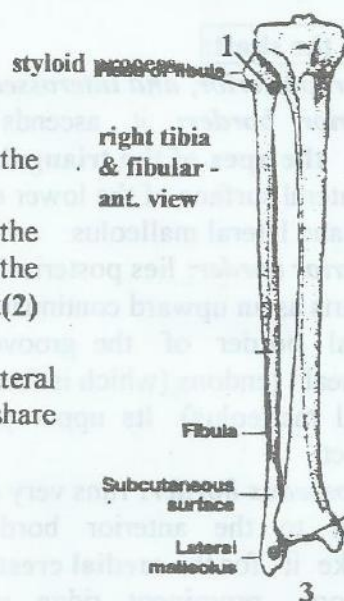
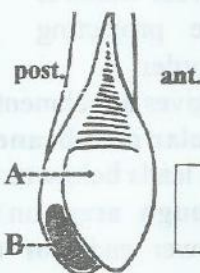
Fibula is the lateral bone of the leg.

Articulations:

- By its head, the fibula articulates with the tibia in the **superior tibiofibular joint(1)** (synovial).
- The rough area found on the lowermost medial part of the shaft of fibula with articulates the fibular notch (on the lower end of tibia) in the **inferior tibiofibular joint(2)** (fibrous joint).
- The articular triangular facet (on the medial side of lateral malleolus) articulates with the lateral side of talus to share in the formation of **ankle joint(3)**.

To identify the fibula right or left:

- The upper end is bulky & formed of head & styloid process.
- The lower end is compressed from side to side.
- The medial side of the lower end presents **triangular articular surface and malleolar fossa**.
- The **triangular articular surface(A)** lies anterior to the **malleolar fossa(B)**.



articulates with talus sharing in the formation of ankle joint

Lower end of fibula

- The fibula has an upper end (called the head), a shaft and a lower end (called lateral malleolus).

Upper end:

- It has a **styloid process(1)** which projects upwards.
- The **head(2)** is followed below by the **neck(3)**.
- Its upper surface has an **articular facet(4)** which articulates with the under surface of the lateral condyle of the tibia to form the **superior tibiofibular joint (synovial type)**.



- The head can easily be felt under the skin (surface landmark). It lies opposite the tibial tuberosity.
- The upper end is related to 3 structures: a muscle, a ligament and a nerve, as follows: (important)
 1. It gives insertion to the **biceps femoris (A)**.
 2. It gives attachment to the **fibular collateral ligament (B)**.
 3. The **common peroneal nerve (C)** is in direct contact with the back of the head as well as with the lateral aspect of the neck.
 4. **Circumflex fibular artery (D)**, which is related to the posterior aspect of the neck.



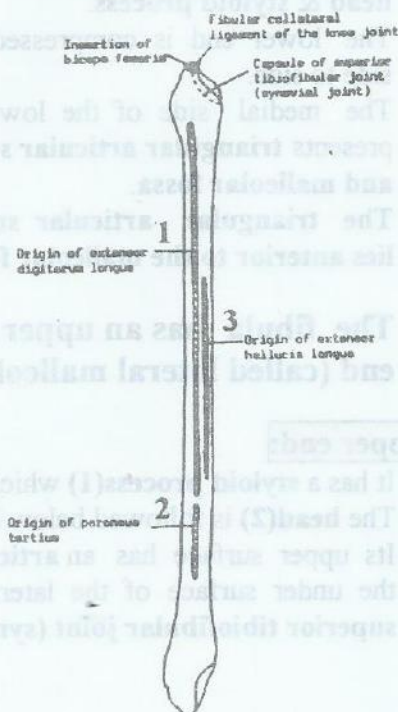
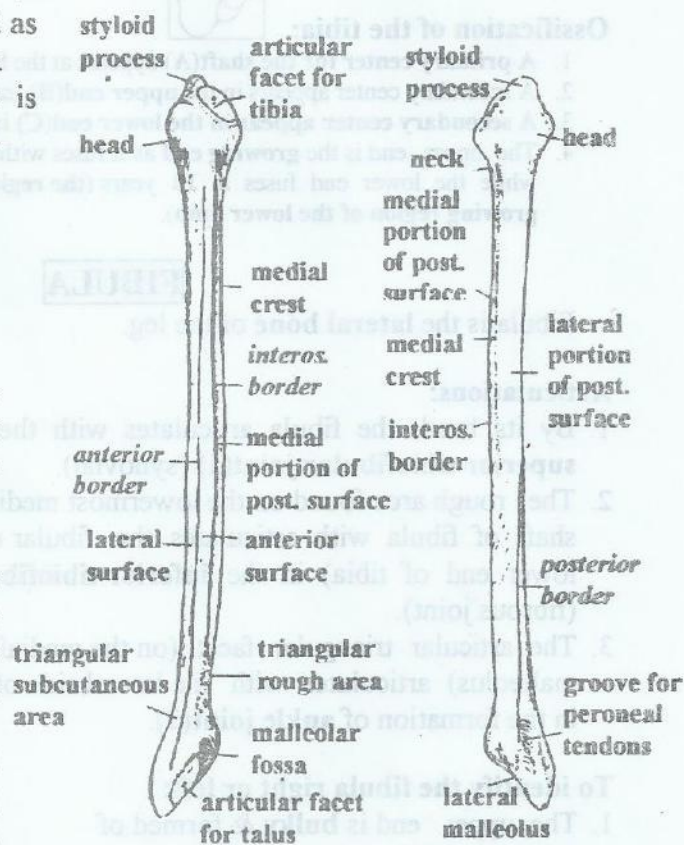
Shaft:

It has 3 borders and 3 surfaces.

Borders of the shaft:

(anterior, posterior, and interosseous)

- **Anterior border:** it ascends upwards from the apex of the triangular area at the lateral surface of the lower end of the shaft and lateral malleolus.
- **Posterior border:** lies posteriorly. It starts as an upward continuation of the medial border of the groove for the peroneal tendons (which is found on the lateral malleolus). Its upper part is less distinct.
- **Interosseous border:** runs very close and medial to the anterior border. Don't mistake it for the medial crest which is a more prominent ridge projecting medial to the interosseous border.
 - The interosseous border gives attachment to the **interosseous tibiofibular membrane**.
 - The interosseous border leads below to the apex of a **triangular rough area** on the medial aspect of the lower end (for the **inferior tibio-fibular joint**).



Surfaces of the shaft: (anterior, lateral and posterior).

- **Anterior (medial) surface:** (very narrow)
- It lies between the anterior and interosseous borders.
- It is also called **extensor surface** because it gives origin to the extensor muscles of the foot as follows:
 - **Extensor digitorum longus (1):** from upper 3/4.
 - **Peroneus tertius (2):** from lower 1/4.
 - **Extensor hallucis longus (3):** from middle 2/4 (medial to the extensor digitorum longus).

- **Lateral surface:**

It lies between the anterior and posterior borders. It is also called **peroneal surface** because it gives origin to 2 peroneal muscles as follows:

- **Peroneus longus(A):** from upper 2/3.
- **Peroneus brevis(B):** from lower 2/3.

- **Posterior surface:**

It lies between the interosseous and posterior borders. The **medial crest** projects from this surface and divides it into 2 vertical areas. This surface is also called **flexor surface** because it gives origin to flexor muscles as follows:

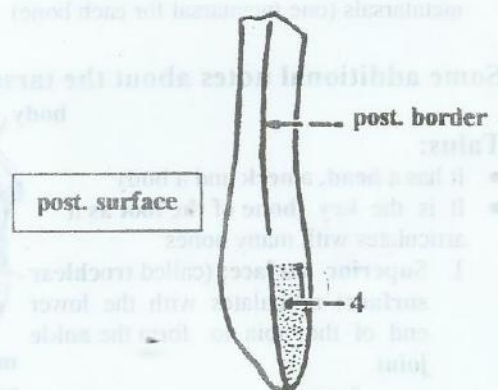
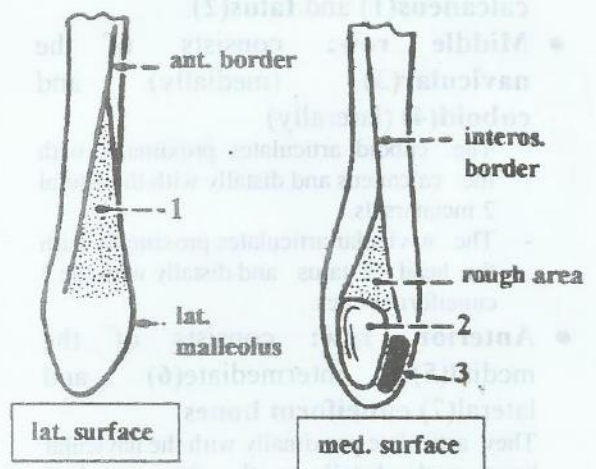
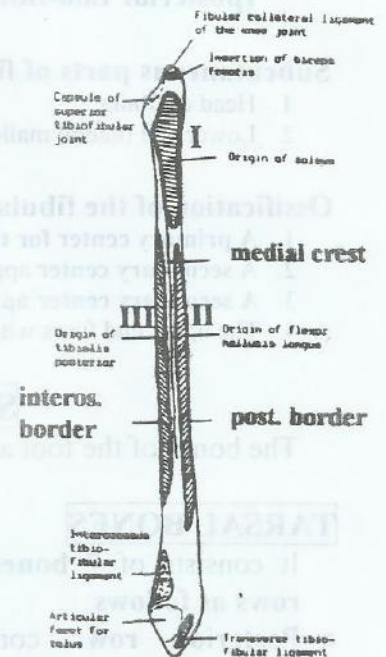
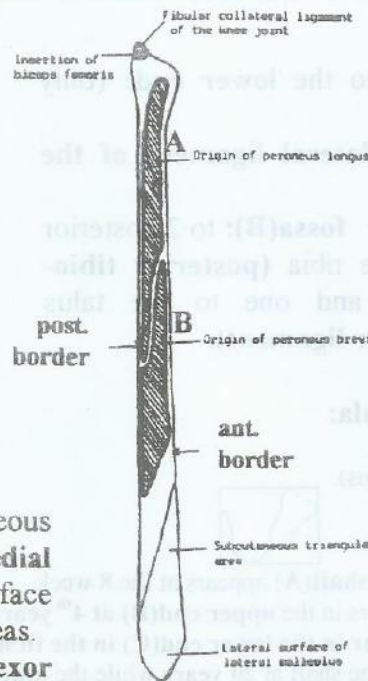
- **Soleus(I):** from upper 1/3.
- **Flexor hallucis longus(II):** from lower 2/3 (below the soleus and lateral to the medial crest).
- **Tibialis posterior(III):** from upper 2/3 (medial to the medial crest).

Lower end (lateral malleolus):

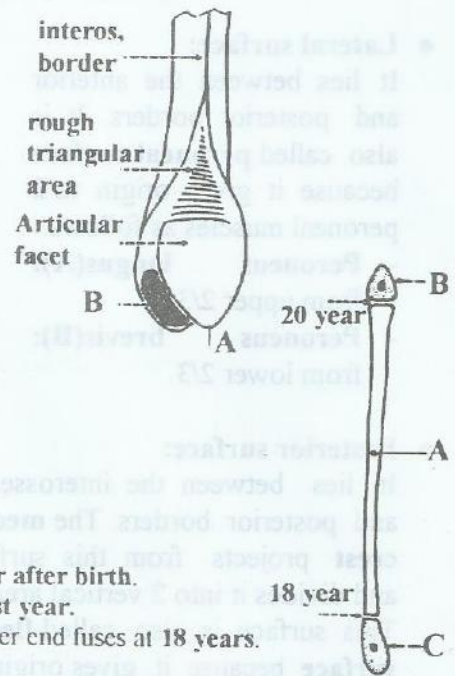
The lower end is called the **lateral malleolus**.

The **lateral malleolus** has the following features:

- **Its tip:** extends lower than the tip of the medial malleolus by 1 cm.
- **Its lateral surface:** is triangular, subcutaneous(1) & converge upwards as the anterior border of the shaft.
- **Its medial surface:** has an anterior **articular smooth area(2)** and a posterior deep depression termed the **malleolar fossa(3)**.
 - The articular area is triangular and articulates with the side of the talus to form a part of the **ankle joint**.
 - Above the articular smooth area, a rough triangular area for the inferior tibiofibular joint.
- **Its posterior surface:** has a **groove(4)** which lodges the tendons of **peroneus longus** and **peroneus brevis**.
The medial border of this groove extends upwards as posterior border of the shaft.

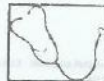


- **Ligaments attached to the lower end: (only ligaments)**
 - From its tip(A): lateral ligament of the ankle.
 - From the malleolar fossa(B): to 2 posterior ligaments-one to the tibia (posterior tibio-fibular ligament) and one to the talus (posterior talo-fibular ligament).



Subcutaneous parts of fibula:

1. Head of fibula.
2. Lower end (lateral malleolus).



Ossification of the fibula:

1. A primary center for the shaft(A) appears at the 8 week.
2. A secondary center appears in the upper end(B) at 4th year after birth.
3. A secondary center appear in the lower end(C) in the first year.
4. The upper end fuses with the shaft at 20 years while the lower end fuses at 18 years.

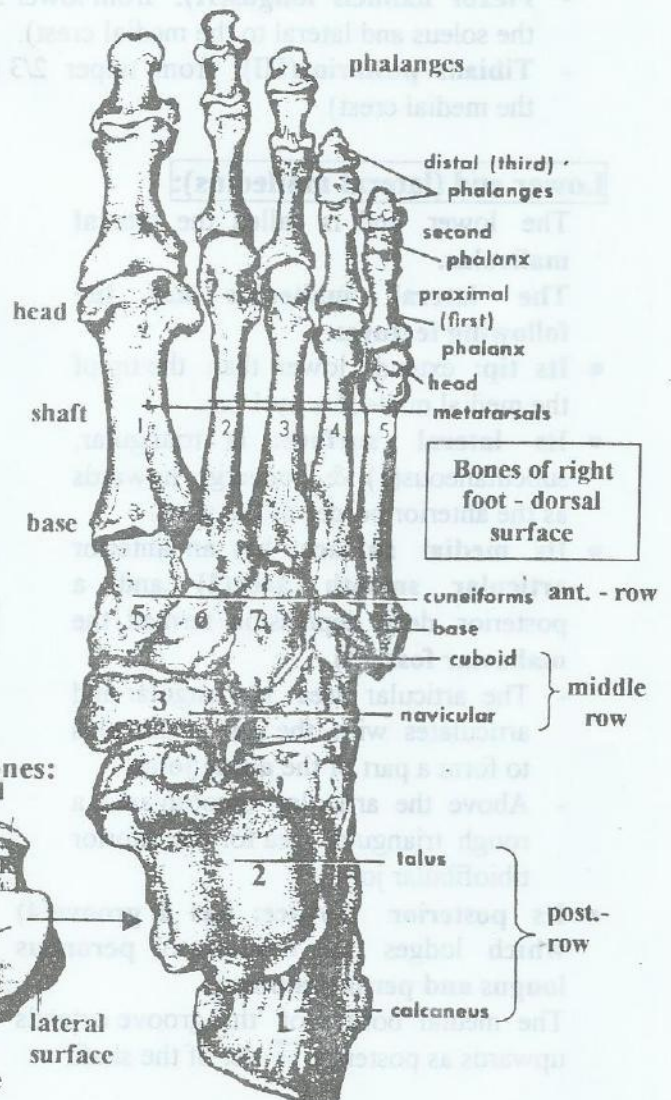
SKELETON OF THE FOOT

The bones of the foot are: tarsus, metatarsus and phalanges.

TARSAL BONES

It consists of 7 bones arranged in 3 rows as follows:

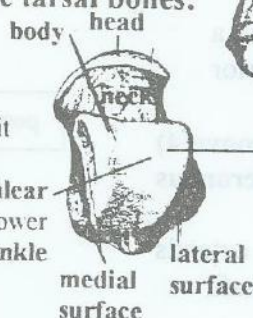
- **Posterior row:** consists of the calcaneus(1) and talus(2).
- **Middle row:** consists of the navicular(3) (medially) and cuboid(4) (laterally).
 - The cuboid articulates proximally with the calcaneus and distally with the lateral 2 metatarsals.
 - The navicular articulates proximally with the head of talus and distally with the 3 cuneiform bones.
- **Anterior row:** consists of the medial(5), intermediate(6) and lateral(7) cuneiform bones. They articulate proximally with the navicular bone and distally with the medial 3 metatarsals (one metatarsal for each bone).



Some additional notes about the tarsal bones:

Talus:

- It has a head, a neck and a body.
- It is the key bone of the foot as it articulates with many bones:
 1. **Superior surface:** (called trochlear surface) articulates with the lower end of the tibia to form the ankle joint.



2. The medial surface and Lateral surface: articulate with the medial malleolus and lateral malleolus respectively in the ankle joint.
3. Inferior surface: articulates with the upper surface of the calcaneus to form subtalar joint.
4. Head of talus: articulates with the navicular bone (talo-navicular joint).

Calcaneus:

- Its medial surface: has a prominent shelf called **sustentaculum tali**(1) (which supports the talus), on the under surface of which lies the **groove**(2) for the **flexor hallucis longus**.
- Its inferior surface(3): carries a rough tuberosity.
- Its posterior surface(4): gives insertion to the **tendo-calcaneus**.

Cuboid:

It has a **groove**(5) on its plantar (lower) surface for the **tendon of peroneus longus** (cuboid = cube-like).

Navicular:

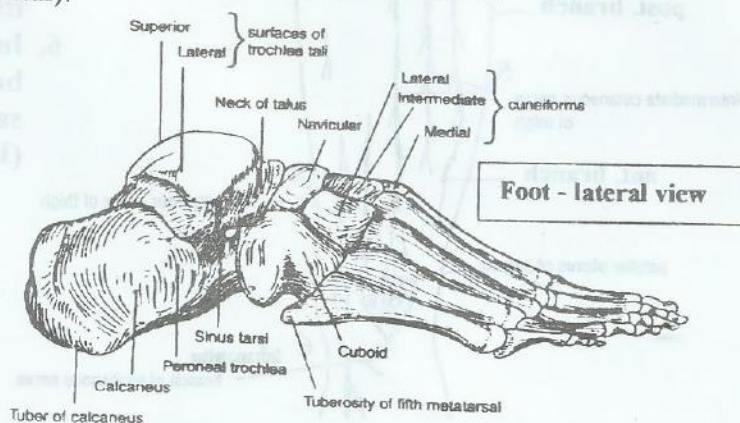
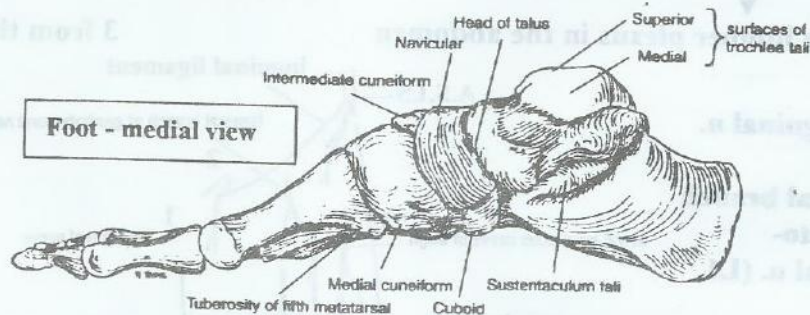
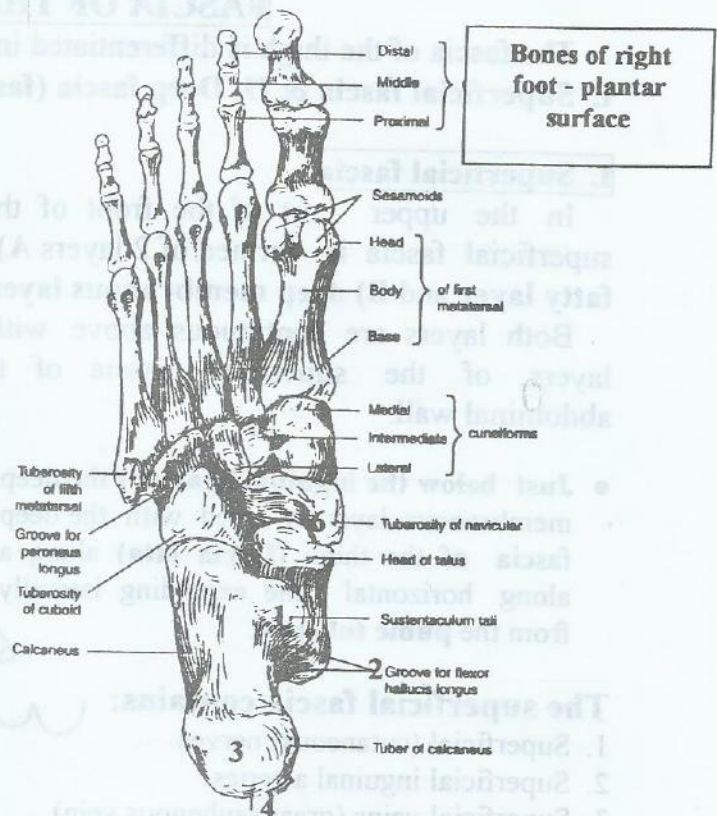
It has a projecting **tuberosity**(6) for the insertion of **tibialis posterior**.

METATARSAL BONES

- There are 5 metatarsals which are numbered from medial to lateral (that of the big toe is the 1st, while that of the little toe is the 5th).
- Each metatarsal has a base, a shaft (body) and a head (as a long bone).
- The base of the 5th metatarsal has a **tuberosity**(7) which projects backwards and laterally. This base gives insertion to 2 **peronei muscles** (brevis and tertius).
- The 1st metatarsal (of the big toe) is the thickest because it bears body weight as twice as that of any of the other metatarsals.

PHALANGES

- 2 phalanges for big toe (proximal & distal).
- 3 phalanges for each of the lateral 4 toes (proximal, middle and distal).



FRONT OF THE THIGH

FASCIA OF THE THIGH

The fascia of the thigh is differentiated into 2 layers:

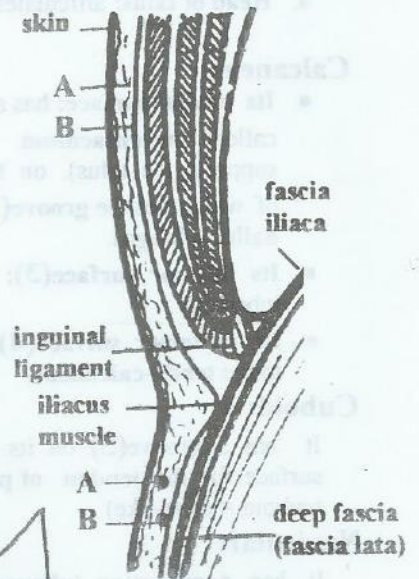
I. Superficial fascia & II. Deep fascia (fascia lata)

I. Superficial fascia

In the upper part of the front of the thigh the superficial fascia is formed of 2 layers A) superficial fatty layer and B) deep membranous layer.

Both layers are continuous above with the similar layers of the superficial fascia of the anterior abdominal wall.

- Just below the inguinal ligament the deep membranous layer is fused with the deep fascia of the thigh (fascia lata) along a horizontal line extending laterally from the pubic tubercle.



The superficial fascia contains:

1. Superficial (cutaneous) nerves.
2. Superficial inguinal arteries.
3. Superficial veins (great saphenous vein).
4. Superficial inguinal lymph nodes.

1. Superficial (cutaneous) nerves

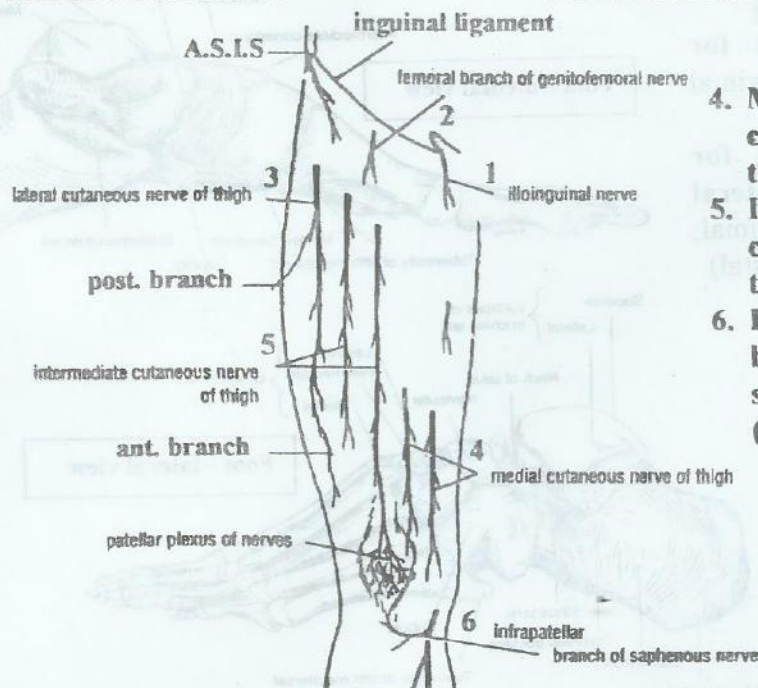
6 cutaneous nerves supply the front of the thigh

3 from lumbar plexus in the abdomen

3 from the femoral nerve

1. Ilio-inguinal n. (L1)
2. Femoral branch of genito-femoral n. (L1, 2).
3. Lateral cutaneous n. of the thigh (L2, 3).

4. Medial cutaneous n. of thigh (L2,3).
5. Intermediate cutaneous n. of thigh (L2,3).
6. Infrapatellar branch of saphenous n. (L2,3).



Some details about the cutaneous nerves:

1. **Ilio-inguinal nerve (L1):** branch of lumbar plexus.
It passes through the superficial inguinal ring and gives branches to the upper part of the medial side of the thigh.
2. **Femoral branch of genito-femoral nerve (branch of lumbar plexus) (L.1,2):** supplies the skin over femoral triangle.
3. **Lateral cutaneous nerve of the thigh (L.2, 3):** branch of the lumbar plexus.
It passes behind the inguinal ligament close to the anterior superior iliac spine (A.S.I.S).
It divides into anterior and posterior branches.
 - The anterior branch reaches to the front of patella.
 - The posterior branch passes backward to supply the skin of the gluteal region.
4. **Medial cutaneous nerve of the thigh (L.2, 3):** branch of femoral nerve.
 - It divides into anterior and posterior branches.
 - The anterior branch ends in front of the patella.
 - The posterior branch ends in the upper part of the leg.
5. **Intermediate cutaneous nerve of the thigh (L.2, 3):** branch of femoral nerve.
 - It divides into medial and lateral branch which descend to the front of patella.
6. **Infra-patellar branch of the saphenous nerve (branch of lumbar plexus) (L.2, 3):**
It pierces the deep fascia on the medial side of the knee to supply the skin over the patella.

N.B.: Patellar plexus: a plexus of nerves in front of the patella formed by:

- i) Lateral, intermediate and medial cutaneous nerves of the thigh.
- ii) Infra patellar branch of saphenous nerve.

→ 2. Superficial inguinal arteries

(1) **Superficial external pudendal artery** runs medially to the **external genital organs**.

(2) **Superficial epigastric artery** runs upwards and medially toward the umbilicus.

(3) **Superficial circumflex iliac artery** runs upwards and laterally along the inguinal ligament and iliac crest.

These arteries are branches of femoral artery.

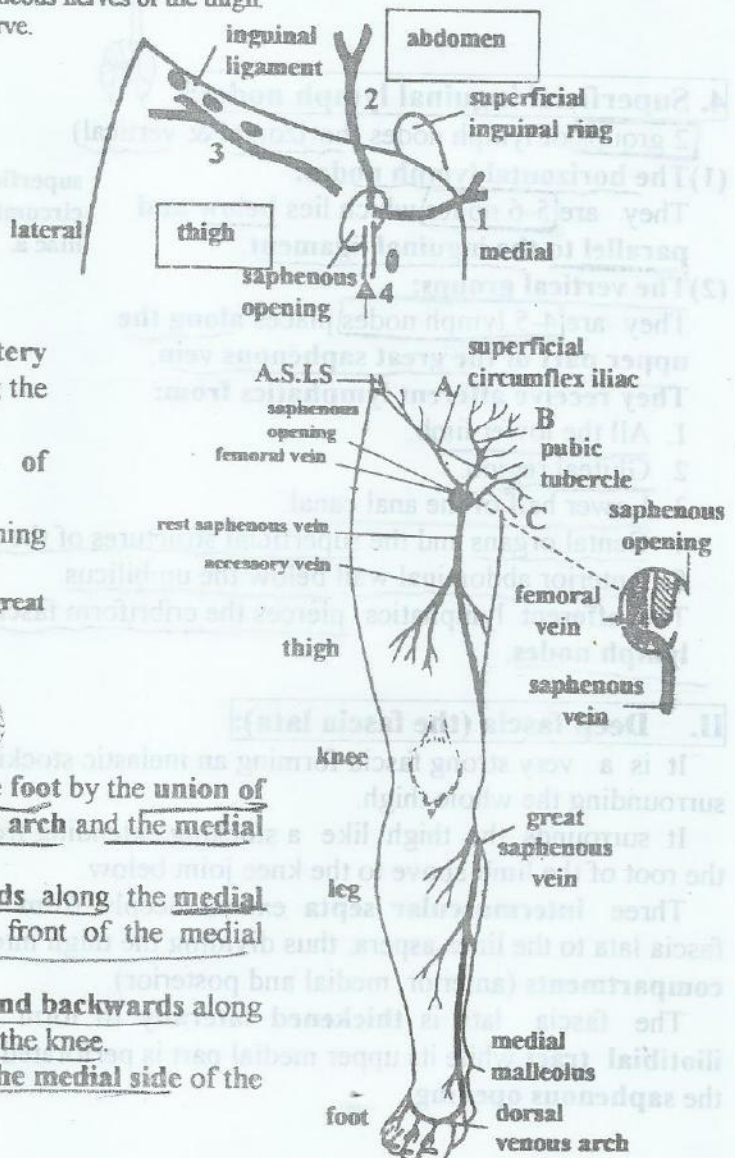
They pass through saphenous opening to reach the superficial fascia.

The corresponding veins end in the great saphenous vein(4).

3. Superficial veins

→ Great (long) saphenous vein

- It begins on the dorsum of the foot by the union of medial part of the dorsal venous arch and the medial dorsal digital vein of the big toe.
- In the foot: it passed backwards along the medial side of the foot and crosses in front of the medial malleolus to enter the leg.
- In the leg: it passes upwards and backwards along the medial side of the leg to reach the knee.
- In the knee: it ascends behind the medial side of the back of the knee.



- In the thigh: it passes upwards along the medial side of the thigh till it reaches the saphenous opening where the saphenous vein turns backwards and pierces the cribriform fascia to join the femoral vein.
- It contains several valves in its interior

Tributaries of the great saphenous vein: (refer to the Fig. in page 29)

It receives the following tributaries:

- Superficial circumflex iliac vein.
- Superficial epigastric vein.
- Superficial external pudendal vein.
- Communicating vein which connect it with the small saphenous vein.
- Communicating veins (perforating veins) which connect it with the deep veins in the lower limb.

Clinical importance of great saphenous vein:

- Great saphenous vein can be used a graft to replace obstructed artery e.g. coronary arteries of the heart. → الدوائى
- Varicose veins: abnormal dilatation & tortuosity of the superficial veins of the lower limb (great & small saphenous vein) due to incompetence of their valves.



4. Superficial inguinal lymph nodes:

2 groups of lymph nodes (horizontal & vertical)

(1) The horizontal lymph nodes:

They are 5-6 nodes which lie below and parallel to the inguinal ligament.

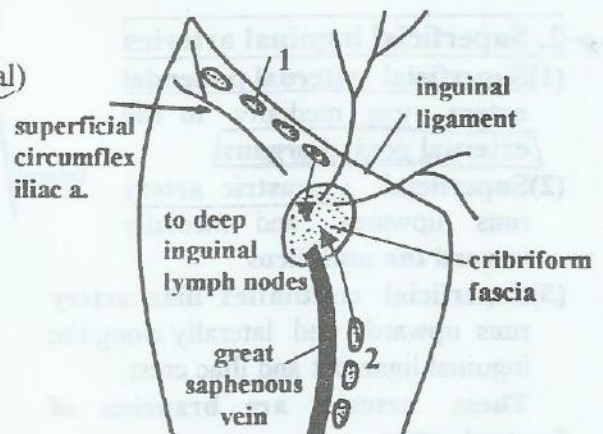
(2) The vertical groups:

They are 4-5 lymph nodes placed along the upper part of the great saphenous vein.

They receive afferent lymphatics from:

- All the lower limb.
- Gluteal region.
- Lower half of the anal canal.
- Gental organs and the superficial structures of the perineum.
- Anterior abdominal wall below the umbilicus.

The afferent lymphatics pierces the cribriform fascia to end in the deep inguinal lymph nodes.



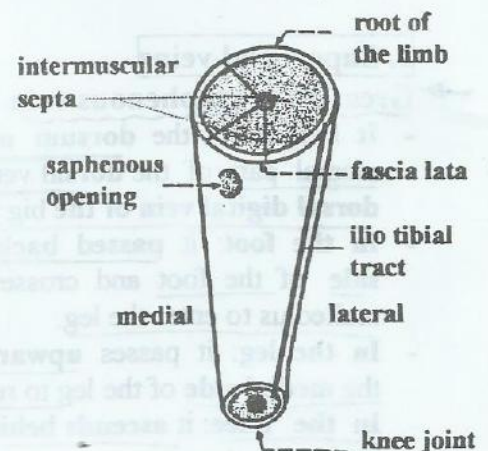
II. Deep fascia (the fascia lata):

It is a very strong fascia forming an inelastic stocking surrounding the whole thigh.

It surrounds the thigh like a stocking extending from the root of the limb above to the knee joint below.

Three **intermuscular septa** extend deeply from the fascia lata to the linea aspera, thus dividing the thigh into 3 **compartments** (anterior, medial and posterior).

The fascia lata is **thickened laterally** to form the **iliotibial tract** while its upper medial part is perforated by the **saphenous opening**.



Iliotibial tract



It is a thickness band of fascia lata 1-2 inch wide lying on the lateral aspect of the thigh.

Attachments:

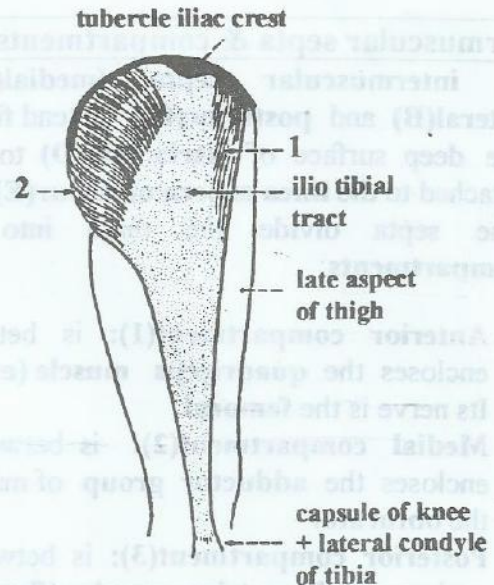
Above: To the tubercle of iliac crest.

Below: It is attached to:

- i. Lateral border of patella.
- ii. Lateral condyle of tibia.
- iii. Capsule of knee joint.

Muscles attached to the iliotibial tract:

- It gives insertion to 2 muscles.
Tensor fascia latae(1): into its anterior border.
The superficial ¾ of the Gluteus maximus(2): into its posterior border.



Functions of iliotibial tract:

1. Extends (prolongs) the insertion of gluteus maximus and tensor fascia latae downwards to reach below the knee joint. This allows the 2 muscles to act on both hip and knee joints.
2. It fixes the condyles of the tibia below the condyles of the femur during prolonged standing.
3. It acts a splint for the knee joint keeping it firmly extended during extension of the limb in the erect position.

Saphenous Opening

It is an oval opening in fascia lata in the upper part of the thigh.

Site: Its center lies 1½ inches below & lateral to the pubic tubercle.

Size: 3 x 1½ cm.

Margins: It has sharp upper, lateral & lower margins which form the falciform margin of the saphenous opening. The medial margin is ill defined.

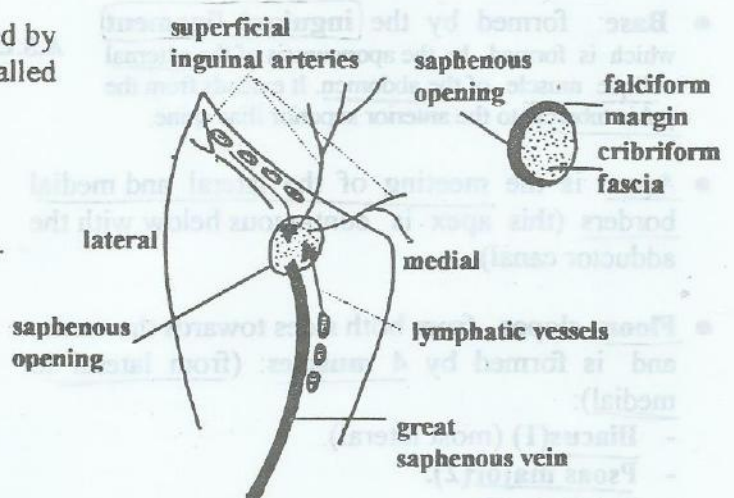
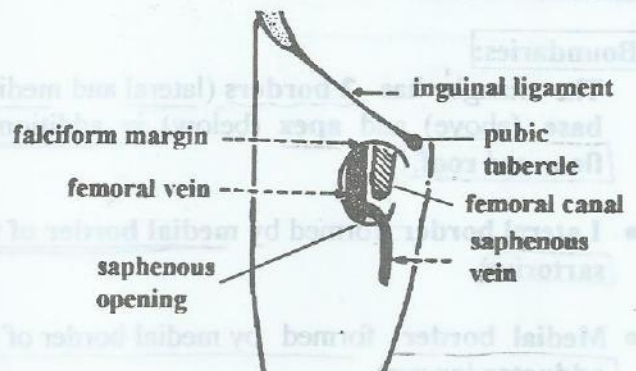
Overlying fascia: The opening is closed by a thin layer of perforated fascia called cribriform fascia.

Underlying structures:

1. Femoral canal medially.
2. The femoral vein lies behind the center.
3. The femoral artery lies behind its lateral margin.

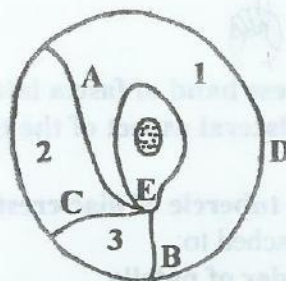
Structures passing through it:

1. Superficial inguinal arteries.
2. Great saphenous vein.
3. Lymphatic vessels.



Intermuscular septa & compartments of thigh:

- 3 intermuscular septa (medial(A), lateral(B) and posterior(C)) extend from the deep surface of fascia lata(D) to be attached to the linea aspera of femur(E). The septa divide the thigh into 3 compartments:



- Anterior compartment(1): is between the medial and lateral septa, and encloses the **quadriceps muscle** (extensors of knee and flexors of hip joints). Its nerve is the **femoral**.
- Medial compartment(2): is between the medial and posterior septa, and encloses the **adductor group** of muscles (adductors of hip joint). Its nerve is the **obturator**.
- Posterior compartment(3): is between the posterior and lateral septa, and encloses the **hamstring muscles** (flexors of knee joint). Its nerve is the **sciatic**.

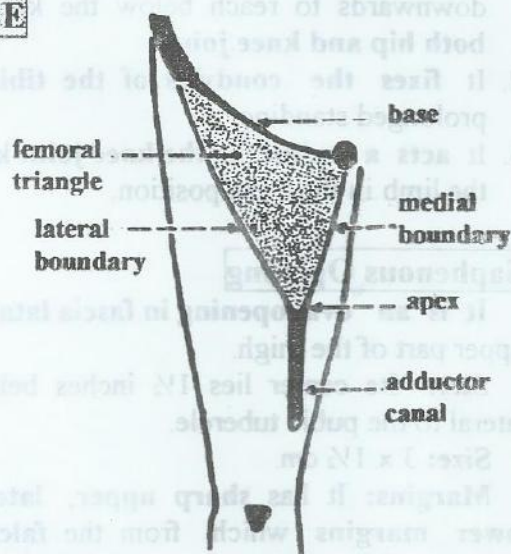


FEMORAL TRIANGLE

It is the triangular hollow in the upper 1/3 of the front of thigh, and is continuous below with the adductor canal.

Boundaries:

The triangle has 2 borders (lateral and medial), base (above) and apex (below) in addition to floor and roof.



- **Lateral border:** formed by medial border of the sartorius.

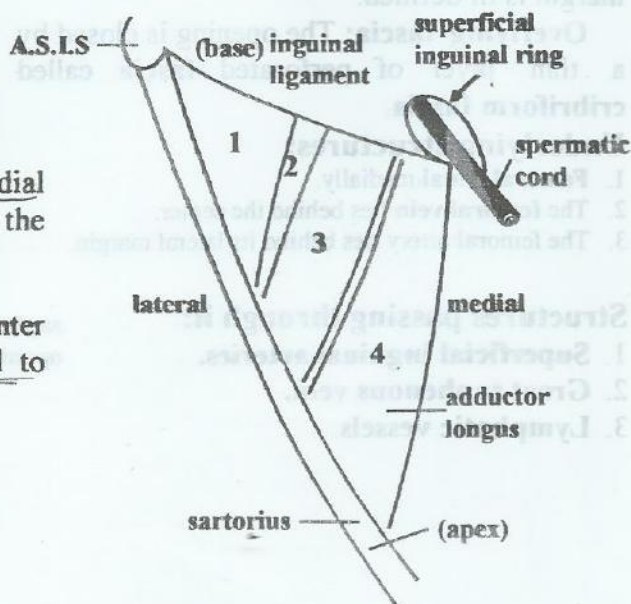
- **Medial border:** formed by medial border of the adductor longus.

- **Base:** formed by the inguinal ligament which is formed by the aponeurosis of the external oblique muscle of the abdomen. It extends from the pubic tubercle to the anterior superior iliac spine.

- **Apex:** is the meeting of the lateral and medial borders (this apex is continuous below with the adductor canal).

- **Floor:** slopes from both sides towards the center and is formed by 4 muscles: (from lateral to medial):

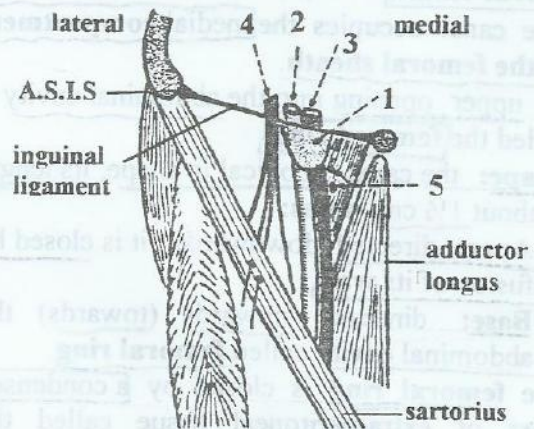
- Iliacus(1) (most lateral).
- Psoas major(2).
- Pectineus(3).
- Adductor longus(4) (most medial).



- **Roof:** it is formed by skin superficial fascia & its contents and the deep fascia.

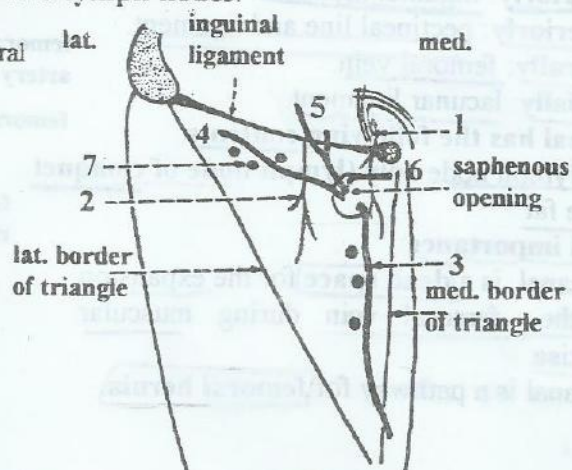
Contents of the femoral triangle:

1. **Femoral sheath:** which surrounds the upper $1\frac{1}{2}$ in sheath of the femoral vessels.
2. **Femoral artery and its branches:** (profunda femoris, deep external pudendal and the 3 superficial inguinal arteries).
3. **Femoral vein and its tributaries.**
4. **Femoral nerve and its branches.**
5. **Deep inguinal lymph nodes.**
6. **Femoral branch of the genito femoral nerve & lateral cutaneous nerve of the thigh.**



Remember that the superficial fascia of the roof of the femoral triangle contains the following nerves, vessels and lymph nodes.

- **Nerves:** ilio-inguinal nerve(1) and femoral branch of genito-femoral nerve(2).
- **Veins:** great saphenous vein(3) and its tributaries.
- **Arteries:** the 3 superficial inguinal arteries of the groin (superficial circumflex iliac(4), superficial epigastric(5), and superficial external pudendal(6)).
- **Superficial inguinal lymph nodes(7).**



Femoral sheath:

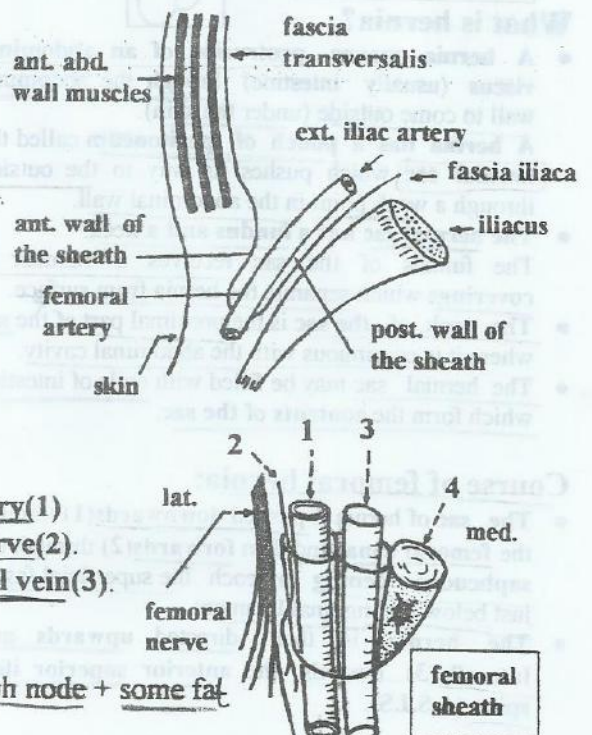
- A funnel-shaped sheath of deep fascia which surrounds the upper one and half inches of the femoral vessels.
- The anterior wall of the sheath is a downward prolongation of the fascia transversalis of anterior abdominal wall.
- The posterior wall of the sheath is a downward prolongation of the fascia iliaca of the posterior abdominal wall.
- The sheath is divided by two septa into three compartments:

Lateral compartment: contains the femoral artery(1) and femoral branch of genito-femoral nerve(2).

Intermediate compartment: contains the femoral vein(3).

Medial compartment:

Called the femoral canal(4), contains one lymph node + some fat.



Femoral canal:

- The canal occupies the **medial compartment of the femoral sheath**.

Its upper opening into the abdominal cavity is called the **femoral ring**.

- Shape:** the canal is conical in shape, its length is about $1\frac{1}{2}$ cm, it has:

- Apex:** directed downwards, it is closed by **fusion of its wall**.

- Base:** directed upwards (towards) the abdominal cavity called **femoral ring**.

- The **femoral ring** is closed by a condensed mass of extra-peritoneal tissue called the **femoral septum**. The ring has the following relations:

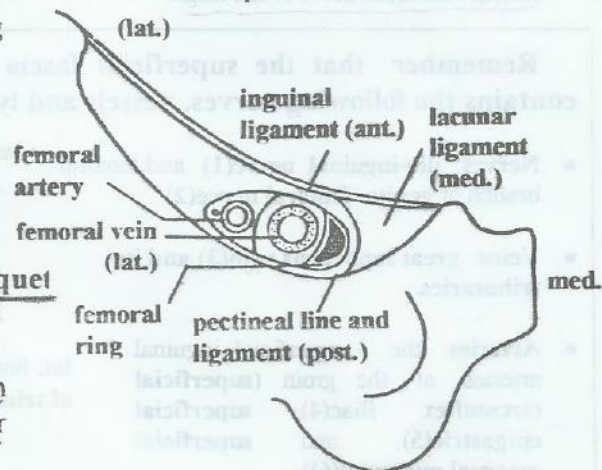
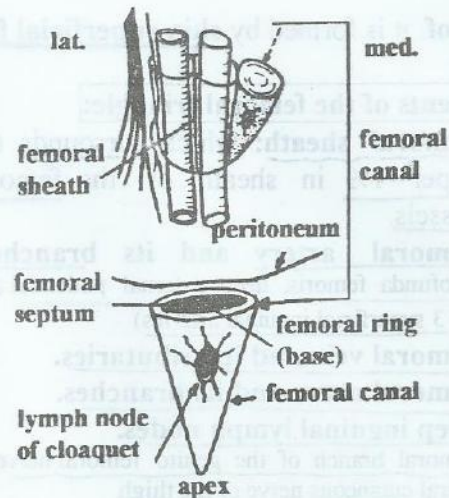
- Anteriorly:** inguinal ligament.
- Posteriorly:** pectineal line and ligament.
- Laterally:** femoral vein.
- Medially:** lacunar ligament.

- The canal has the following contents:

- One lymph node only** (lymph node of **cloquet**).
- Some fat**.

- Clinical importance:**

- the canal is a **dead space** for the expansion of the **femoral vein** during muscular exercise.
- the canal is a pathway for **femoral hernia**.

**Femoral hernia:****What is hernia?**

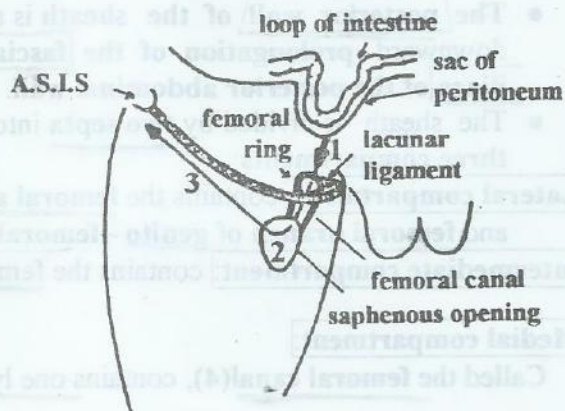
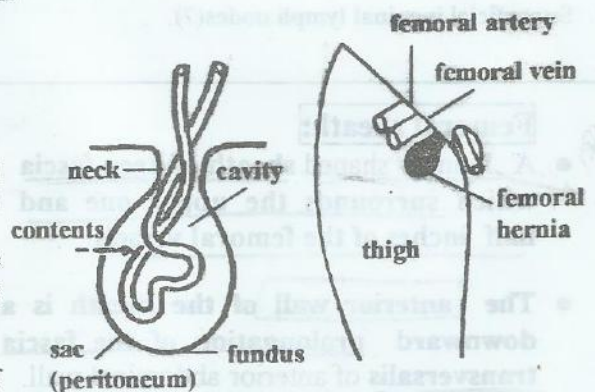
- A **hernia** means protrusion of an abdominal viscus (usually intestine) through the abdominal wall to come outside (under the skin).

A hernia has a **pouch of peritoneum** called the **hernial sac** which pushes its way to the outside through a weak point in the abdominal wall.

- The **hernial sac** has a **fundus** and a **neck**. The fundus of the sac receives a number of coverings which separate the hernia from surface.
- The **neck of the sac** is the proximal part of the sac where it is continuous with the abdominal cavity.
- The **hernial sac** may be filled with coils of intestine which form the contents of the sac.

Course of femoral hernia:

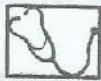
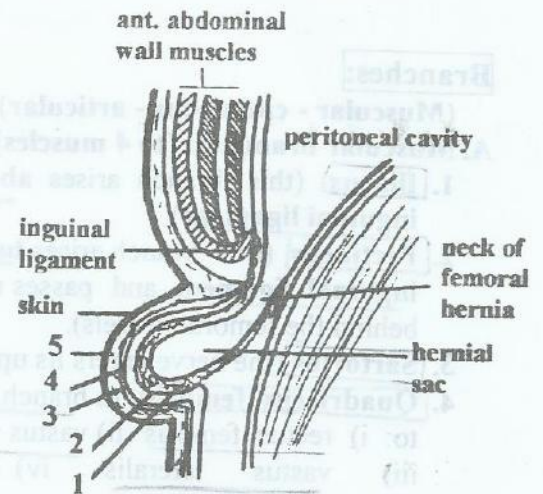
- The **sac of hernia** is pushed downwards (1) through the **femoral canal** and then forwards (2) through the **saphenous opening** to reach the superficial fascia just below the inguinal ligament.
- The **hernia** is then directed upwards and laterally (3) towards the **anterior superior iliac spine (A.S.I.S.)**.



- The neck of the sac lies at the femoral ring.
- The fundus of the sac is separated from the skin by the following coverings (from within outwards):
 - Stretched femoral septum(1).
 - Anterior wall of the femoral canal(2).
 - Cribriform fascia(3).
 - Two layers of superficial fascia(4&5).
 - skin.

N.B.: The femoral hernia is more frequent in females than in males due to:

1. The female pelvis is wide and consequently the femoral canal is wider in the female than in the male.
2. The female muscles are thin.
3. Repeated pregnancies diminish the tone of the abdominal muscles and predispose to hernia formation.



Differences between inguinal and femoral hernia

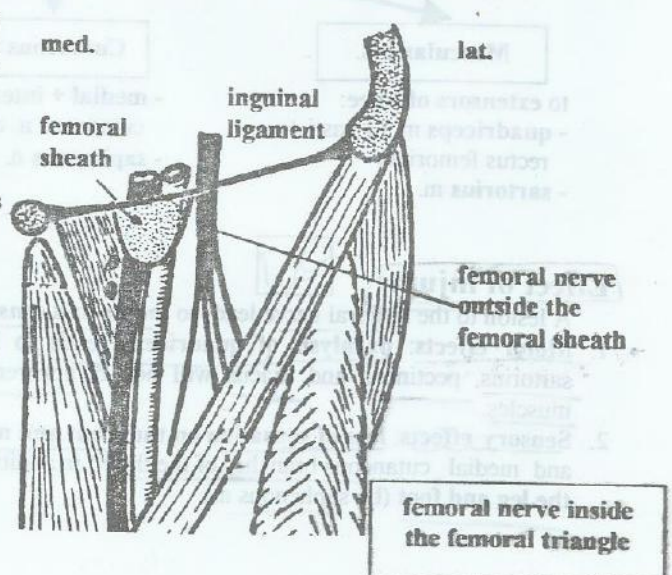
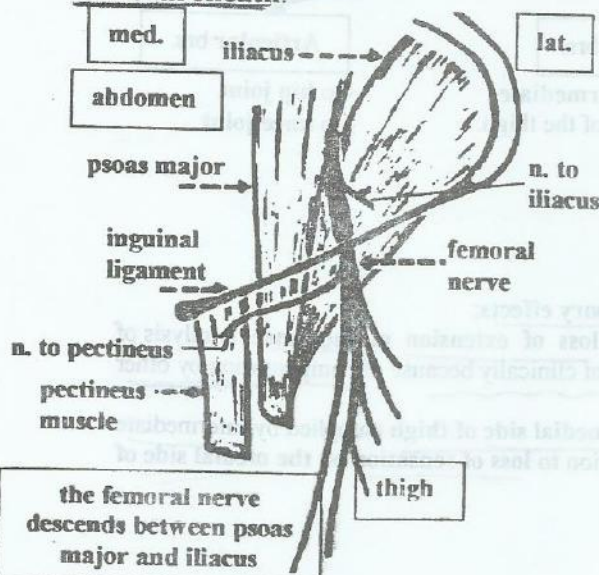
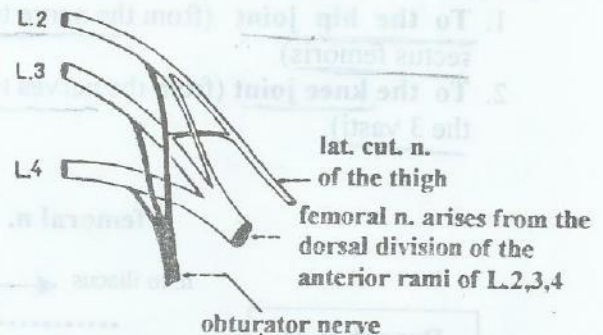
Inguinal hernia	Femoral hernia
1. Hernia is more common in males.	1. Hernia is more common in females.
2. Hernia bulges above the inguinal ligament.	2. Hernia bulges below the inguinal ligament.
3. Hernia sac is above the pubic tubercle.	3. Hernia sac is below the pubic tubercle.

→ Femoral nerve:



Course and relations:

- It arises inside the abdomen from the lumbar plexus from the dorsal divisions of the anterior primary rami of L. 2, 3, 4.
- The femoral nerve emerges at the lateral margin of psoas major between it and the iliacus, a short distance above the inguinal ligament.
- It enters the front of the thigh deep to the inguinal ligament where it ends 1 inch below that ligament by giving off muscular, cutaneous and articular branches.
- The femoral nerve lies lateral to the femoral artery, but it lies outside the femoral sheath.



Branches:

(Muscular - cutaneous - articular)

A. Muscular branches: (to 4 muscles)

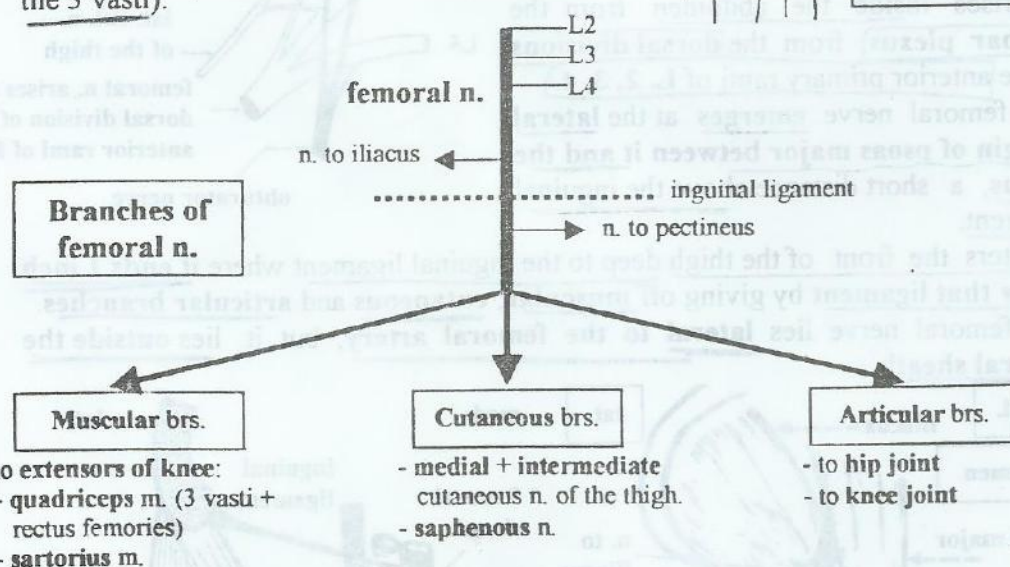
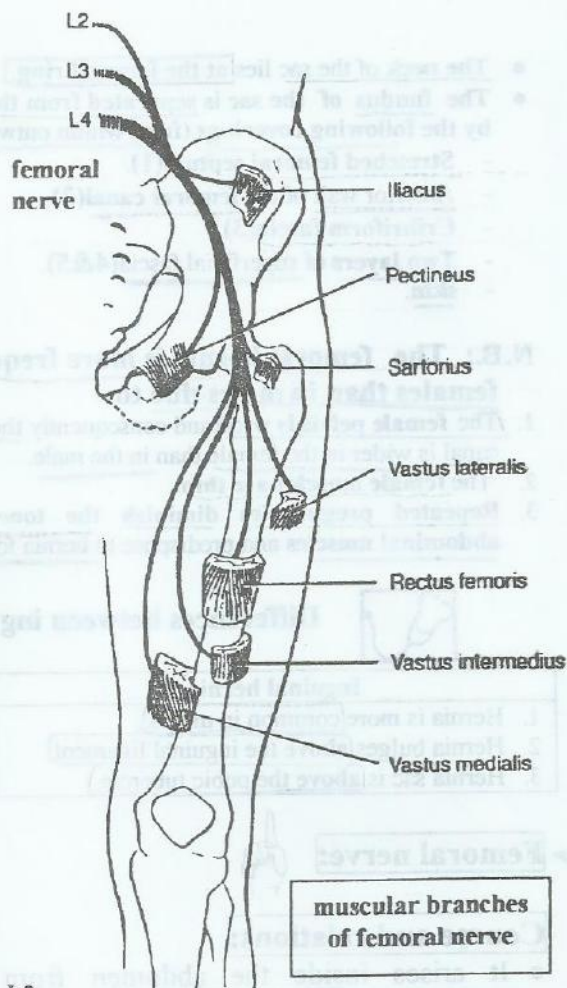
1. **Iliacus** (this branch arises above the inguinal ligament).
2. **Pectineus** (this branch arises below the inguinal ligament and passes medially behind the femoral vessels).
3. **Sartorius** (the nerve enters its upper part).
4. **Quadriceps femoris** (a branch or more to: i) rectus femoris ii) vastus medialis iii) vastus lateralis iv) vastus intermedius).

B. Cutaneous branches: (3)

1. **Saphenous nerve**: to the skin of the medial side of the leg and foot.
2. **Medial cutaneous nerve of thigh**: to the skin of the medial side of the thigh.
3. **Intermediate cutaneous nerve of thigh**: to the skin of the intermediate area of the front of the thigh.

C. Articular branches: (2)

1. **To the hip joint** (from the nerve to rectus femoris).
2. **To the knee joint** (from the nerves to the 3 vasti).

**Effect of injury:**A lesion to the femoral nerve leads to motor and sensory effects:

1. **Motor effects**: paralysis of quadriceps leads to loss of extension of the knee. Paralysis of sartorius, pectineus and iliacus will not be apparent clinically because of compensation by other muscles.
2. **Sensory effects**: loss of sensation on the front and medial side of thigh (supplied by intermediate and medial cutaneous branches of the thigh) in addition to loss of sensation on the medial side of the leg and foot (by saphenous n.).

More details about saphenous nerve

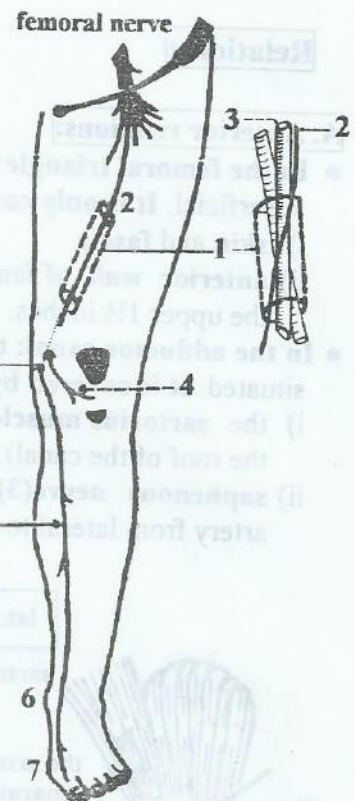
This nerve is the longest branch of the femoral nerve.

Course in the thigh:

- It arises from the femoral nerve and descends lateral to the femoral artery in the femoral triangle.
- It leaves the triangle and enters the adductor canal(1) where the saphenous nerve(2) crosses over the femoral artery(3) to descend along its medial side.
- It then leaves the adductor canal and it immediately gives off its infra-patellar branch(4) which supply the skin over the patella.
- The saphenous nerve pierces the deep fascia at the medial side of the knee(5).

Course in the leg and foot:

- The nerve descends along the medial side of the knee and runs along the medial border of the tibia in company with the great saphenous vein.
- It then passes in front of the medial malleolus(6) and continues on the medial side of the foot(7) as far as the metatarso-phalangeal joint.

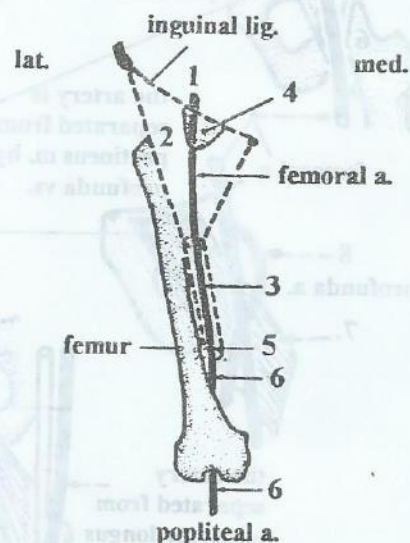


Femoral artery



Course:

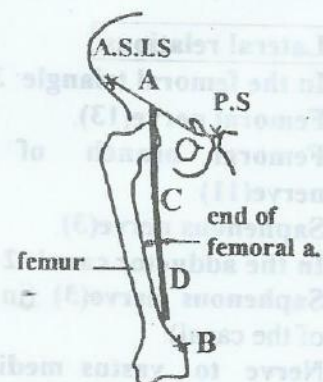
- It begins at the mid-inguinal point as the continuation of the external iliac artery(1).
- Its upper 1/2 lies in the femoral triangle(2) while its lower 1/2 lies in the adductor canal(3).
- Its uppermost part (3-4 cm) is surrounded by the femoral sheath(4).
- It ends at the opening(5) in the adductor magnus where it enters the popliteal fossa and becomes the popliteal artery(6).



Surface anatomy:

- With the thigh flexed, abducted and laterally rotated:
 - Draw a line from the mid-inguinal point(A) to the adductor tubercle(B).
 - The upper 2/3 of this line represents the femoral artery(C).
 - The lower 1/3 represents the popliteal artery(D).

N.B.: the mid-inguinal point(A) lies midway between the anterior superior iliac spine (A.S.I. S) and the pubic symphysis (P.S).

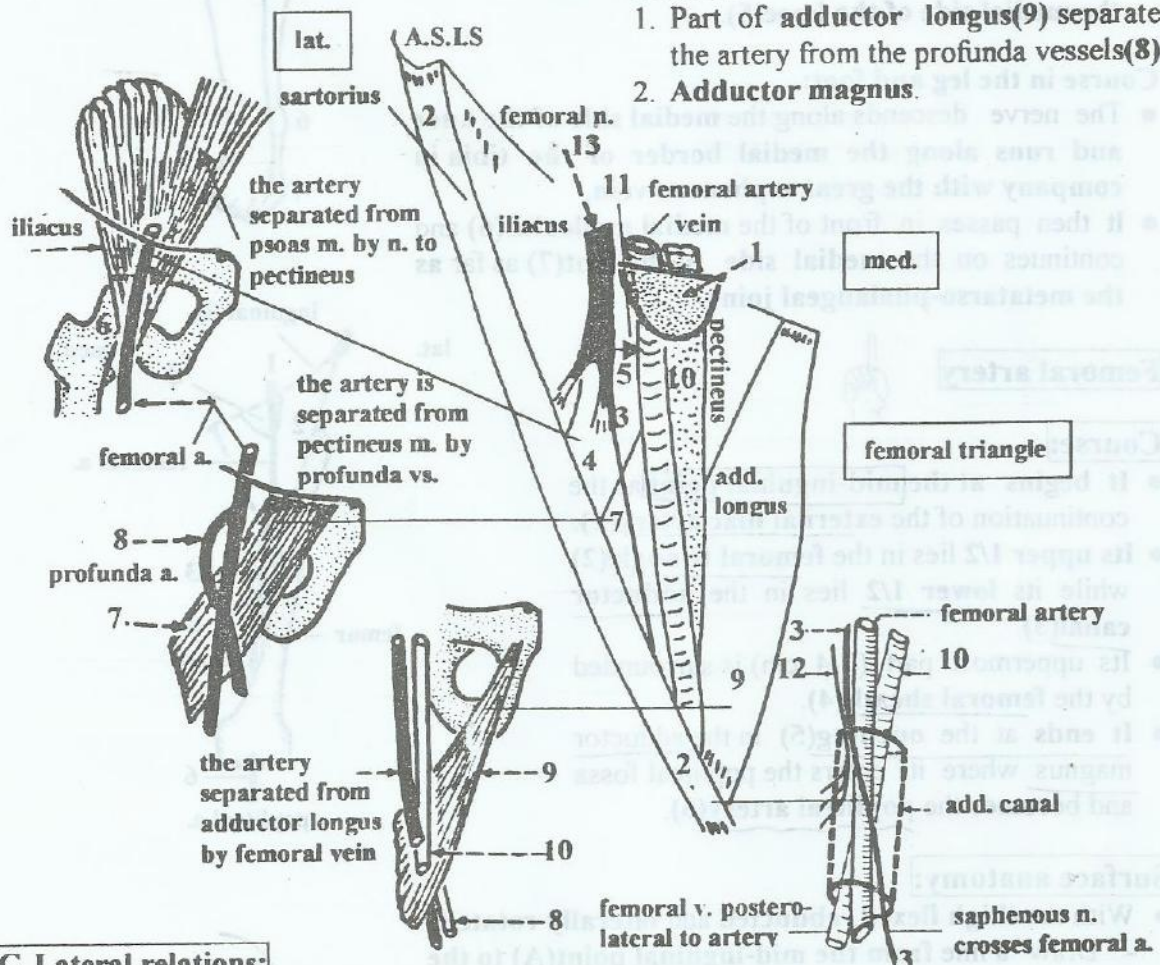


Relations:**A. Anterior relations:**

- In the femoral triangle: the artery is more superficial. It is only covered by:
 - i) skin and fascia
 - ii) anterior wall of femoral sheath(1) in the upper 1½ inches.
- In the adductor canal: the artery is deeply situated. It is covered by:
 - i) the sartorius muscle(2) (which lies on the roof of the canal).
 - ii) saphenous nerve(3) which crosses the artery from lateral to medial.

B. Posterior relations:

- In the femoral triangle: it crosses over 3 muscles:
 1. Psoas major(4) + nerve to pectineus(5).
 2. Pectineus(7) + profunda femoris vessels(8).
 3. Part of adductor longus(9) + femoral vein(10).
- In the adductor canal: it crosses over 2 muscles:
 1. Part of adductor longus(9) separates the artery from the profunda vessels(8).
 2. Adductor magnus.

**C. Lateral relations:**

- In the femoral triangle: 3 nerves
 1. Femoral nerve(13).
 2. Femoral branch of genito-femoral nerve(11).
 3. Saphenous nerve(3).
- In the adductor canal: 2 nerves
 1. Saphenous nerve(3) (in the Upper part of the canal).
 2. Nerve to vastus medialis(12) (in the upper part of the canal).

D. Medial relations:

- In the femoral triangle: femoral vein(13).
- In the adductor canal: saphenous nerve(3).
(N.B.: In the canal the femoral vein lies postero-lateral to the artery).

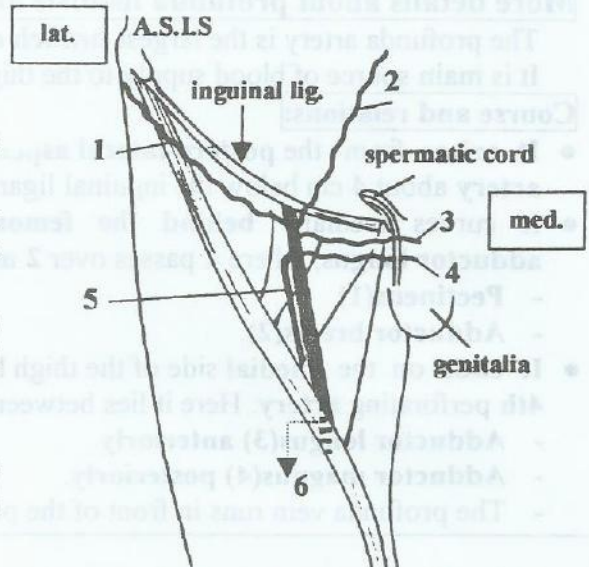
Branches:

These are 3 superficial and 3 deep.

A. The superficial branches:

They run in the superficial fascia and are distributed to the inguinal region.

- **Superficial circumflex iliac(1):** Passes laterally to the anterior superior iliac spine (A.S.I.S).
- **Superficial epigastric(2):** ascends in the lower part of the anterior abdominal wall as far as the umbilicus.
- **Superficial external pudendal(3):** passes medially superficial to the spermatic cord to reach the external genitalia.

**B. Deep branches:**

They run deeply beneath the deep fascia.

- **Deep external pudendal(4):** arises close to the inguinal ligament and passes medially deep to the femoral vein to reach the external genitalia. It runs deep to the spermatic cord.
- **Profunda femoris(5):** (the largest) arises from the postero-lateral aspect of the femoral artery about 4 cm below the inguinal ligament. It curves medially behind the femoral artery to reach the medial side of the thigh where it ends.
- **Descending genicular(6):** (lowermost) arises from the femoral artery in the adductor canal just above the opening in the adductor magnus. It passes downwards to the knee.

Applied anatomy:

Compression of the femoral artery is most effective just below the inguinal ligament where it is compressed against the superior pubic ramus.

Don't forget that: about the relations & branches of femoral artery**Relations:**

Anteriorly: i) skin, ii) fascia, iii) anterior wall of femoral sheath.

Posteriorly: 4 muscles: i) psoas major, ii) pectineus, iii) adductor longus & iv) adductor magnus.

Medially: i) femoral vein, ii) saphenous nerve (in the adductor canal).

Laterally: i) femoral nerve, ii) saphenous nerve.

Branches:

3 superficial + 3 deep branches

3 superficial branches:

- i) superficial external pudendal
- ii) superficial circumflex iliac
- iii) superficial epigastric

3 deep branches:

- i) deep external pudendal
- ii) Profunda femoris.
- iii) descending genicular (in the adductor canal)

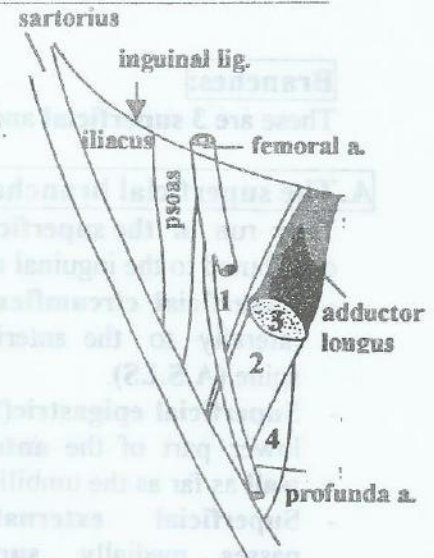


More details about profunda femoris artery:

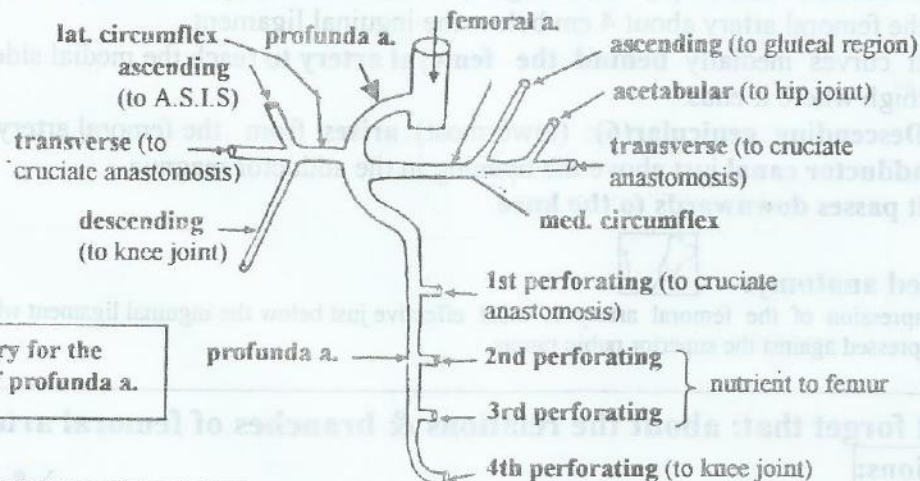
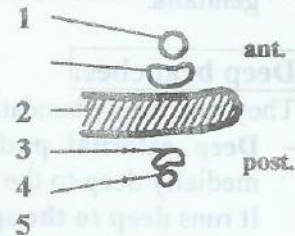
The profunda artery is the largest branch of femoral artery.
It is main source of blood supply to the thigh.

Course and relations:

- It arises from the postero-lateral aspect of the femoral artery about 4 cm below the inguinal ligament.
- It curves medially behind the femoral artery and adductor longus, where it passes over 2 muscles:
 - Pectineus(1).
 - Adductor brevis(2).
- It ends on the medial side of the thigh by becoming the 4th perforating artery. Here it lies between 2 muscles:
 - Adductor longus(3) anteriorly.
 - Adductor magnus(4) posteriorly.
- The profunda vein runs in front of the profunda artery and ends in the femoral vein.



N.B.: At the apex of the femoral triangle the order of structures from anterior to posterior is as follows:
femoral artery(1), femoral vein(2), adductor longus(3), profunda vein(4), profunda artery(5).



Summary for the
branches of profunda a.

Branches of profunda artery:

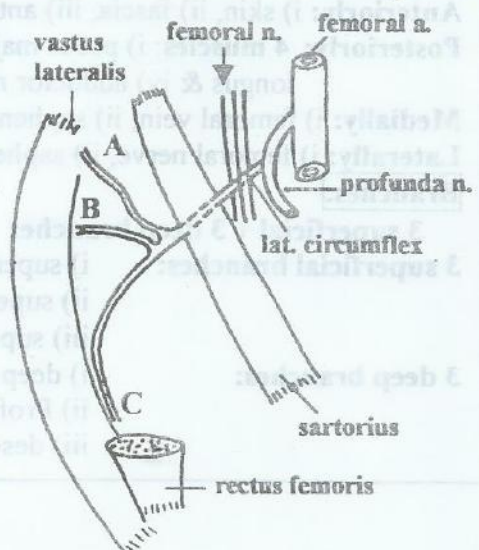
It gives off 2 circumflex and 4 perforating branches.

1. Lateral circumflex femoral:

It passes laterally deep to the sartorius and rectus femoris where it gives off 3 branches (ascending(A), transverse(B) and descending(C)):

A. Ascending branch: ascends towards the anterior superior iliac spine deep to the tensor fasciae latae muscle.

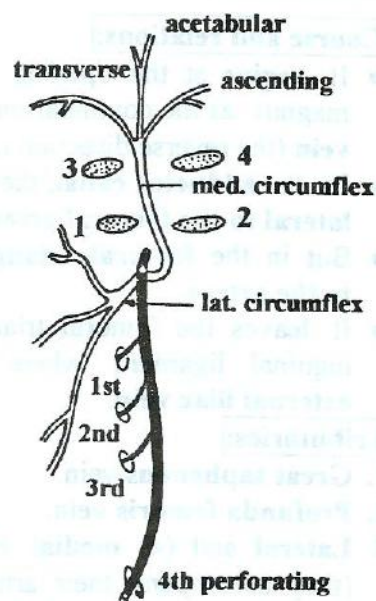
B. Transverse branch: passes transversely and pierces the vastus lateralis to wind round the femur just below the greater trochanter to share in cruciate anastomosis.



C. Descending branch: descends along the anterior border of the vastus lateralis to reach the knee joint.

2. Medial circumflex femoral:

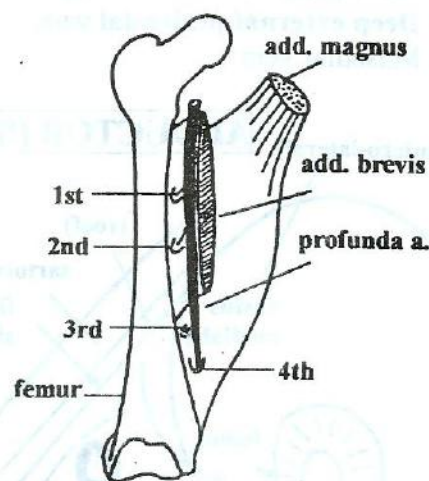
- It passes **backwards** among the muscles in the **medial side of thigh**.
- At 1st it passes between the **psoas major(1)** and **pectineus(2)** then between the **obturator externus(3)** and **adductor brevis(4)**.
- Here, it gives off an **acetabular branch** to hip joint.
- It appears on the back of the thigh at the **upper border of the adductor magnus** where it divides into ascending and transverse branches as follows:
 - Ascending branch:** ascends in the **gluteal region** to anastomose with inferior gluteal artery.
 - Transverse branch:** passes transversely to anastomose with the transverse branch of the lateral circumflex artery in **cruciate anastomosis**.



3. Perforating arteries:

These are 4 arteries which **pierce (perforate)** the **insertions of the adductor brevis and adductor magnus** to reach the back of the thigh.

- They anastomose with each other at the back of femur.
- The **first perforating artery** ascends to join the inferior gluteal artery and takes part in the **cruciate anastomosis**.
- The **2nd & 3rd perforating** give **nutrient arteries** to the femur.
- The **4th perforating artery** descends (terminal part of profunda) to anastomose with branches of **popliteal artery**.



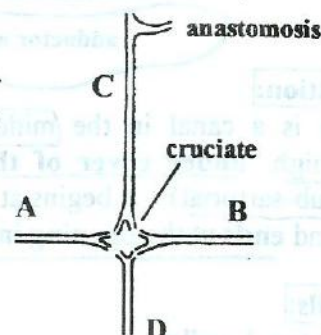
Cruciate anastomosis

Position and formation:

It is a **cross-shaped (†)** anastomosis which lies in the **upper part of the back of the thigh** just below the greater trochanter (cruciate = resembling a cross).

It is formed of a **transverse part** and a **vertical part** as follows:

- **Transverse part:** formed by:
 1. **Transverse branch of lateral circumflex(A)** (from profunda a.).
 2. **Transverse branch of medial circumflex(B)** (from profunda a.).
- **Vertical part:** formed by:
 1. **From above: inferior gluteal(C)** (from internal iliac artery) and ascending branch of the medial circumflex.
 2. **From below: ascending branch of the 1st perforating artery** (from profunda a.).



Applied anatomy:

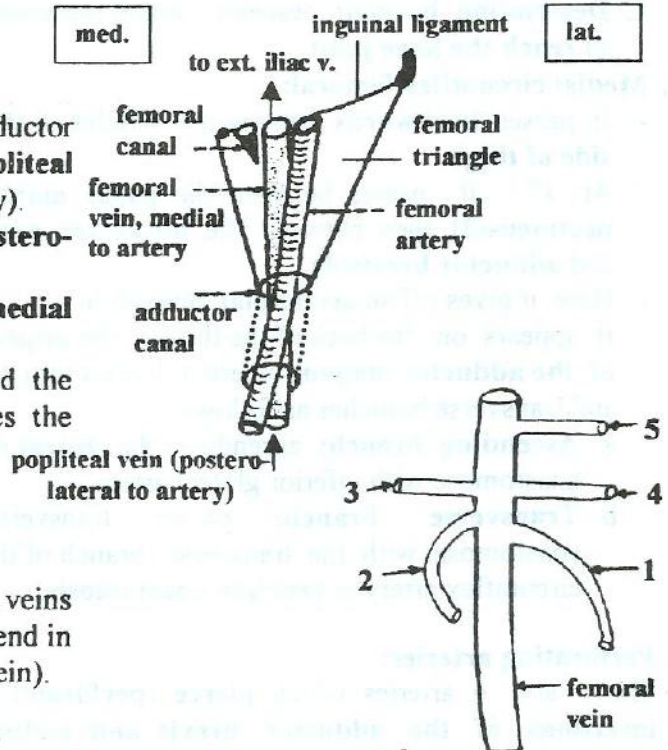
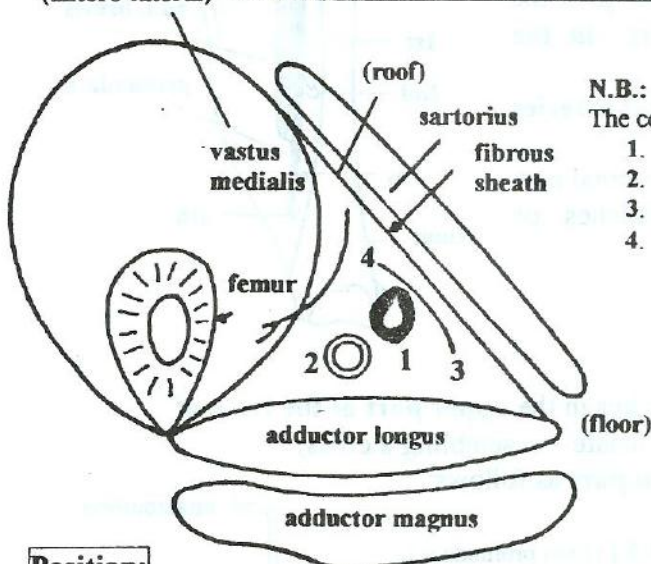
It is of importance in occlusion of either the external iliac or the femoral artery **above the origin of the profunda femoris**. In such a condition the collateral circulation passes through the cruciate anastomosis to reach the limb distal to the site of occlusion.

Femoral vein**Course and relations:**

- It begins at the opening in the adductor magnus as the continuation of the popliteal vein (the reverse direction of the artery).
- In the adductor canal, the vein is **postero-lateral** to the femoral artery.
- But in the femoral triangle it lies **medial** to the artery.
- It leaves the femoral triangle behind the inguinal ligament where it becomes the external iliac vein.

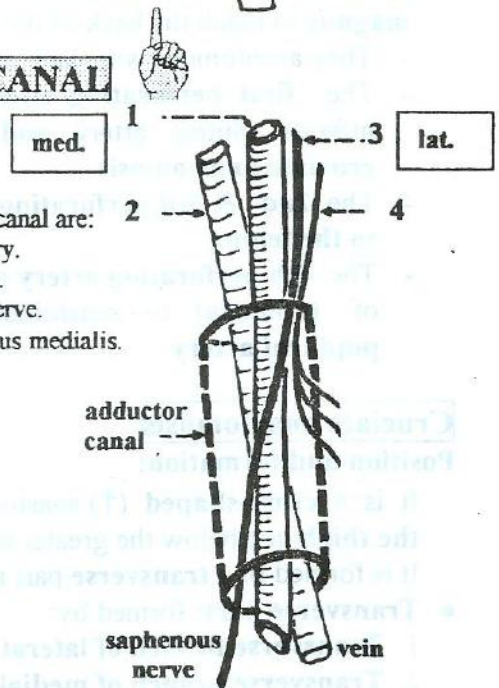
Tributaries:

1. Great saphenous vein.
2. Profunda femoris vein.
3. Lateral and (4) medial circumflex veins (they accompany their arteries and end in the femoral vein instead of profunda vein).
5. Deep external pudendal vein.
6. Muscular vein.

**(antero-lateral) ADDUCTOR (SUBSARTORIAL) CANAL****N.B.:**

The contents of the canal are:

1. Femoral artery.
2. Femoral vein.
3. Saphenous nerve.
4. Nerve to vastus medialis.

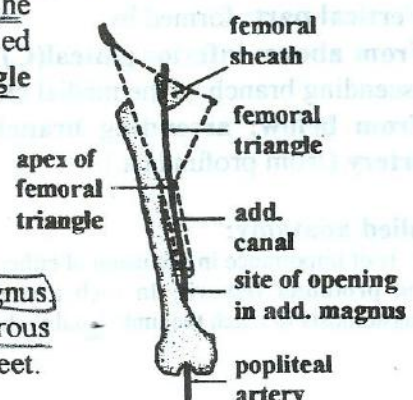
**Position:**

It is a canal in the middle 1/3 of the medial side of the thigh, under cover of the sartorius muscle (hence called sub-sartorial). It begins at the apex of the femoral triangle and ends at the opening in the adductor magnus.

Walls:

It has 3 walls:

1. **Anterior (antero-lateral) wall:** vastus medialis.
2. **Posterior wall (floor):** adductor longus and adductor magnus.
3. **Roof (antero-medial wall):** is formed by a thick fibrous sheet as well as by the sartorius muscle overlying this sheet.



Contents: (2 vessels and 2 nerves).

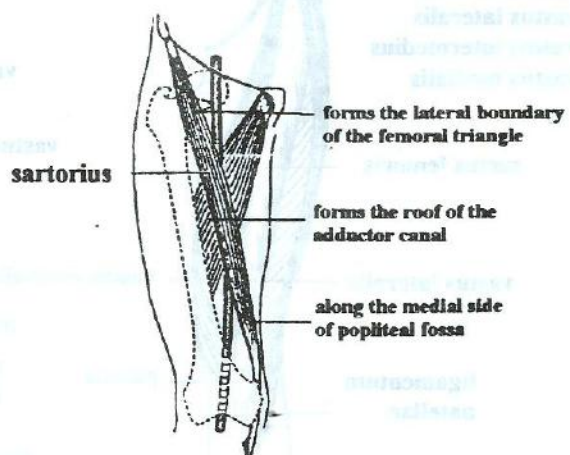
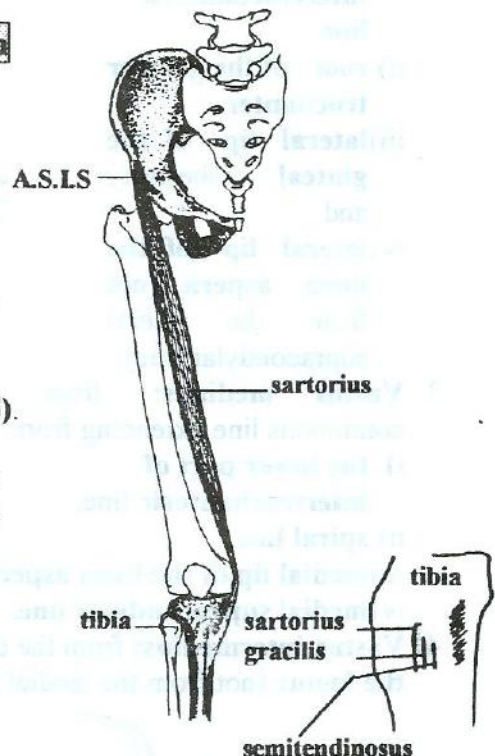
- (1) **Femoral artery:** enters the canal through its upper end and leaves it through its lower end. The femoral artery gives off the descending genicular branch (to the knee joint) near the lower end of the canal.
- (2) **Femoral vein:** is postero-lateral to the femoral artery at the lower end of the canal, but becomes posterior to the artery at its upper end.
- (3) **Saphenous nerve:** lies lateral to the femoral artery in the upper part of the canal then crosses in front of it to come on its medial side in the lower part of the canal. It leaves the canal by piercing its roof at the posterior border of the sartorius just above the lower end of the canal.
- (4) **Nerve to vastus medialis:** lies lateral to the femoral artery in the upper part of the canal. It runs in direct contact with the vastus medialis into which it sinks at the middle of the canal.

Muscles of the front of thigh

- These are the sartorius, quadriceps femoris and iliopsoas.
- All are extensors of the knee and supplied by femoral nerve
- The iliopsoas flex the hip

Sartorius

- **Origin:** from the **anterior superior iliac spine (A.S.I.S)**.
- **Insertion:** into the upper part of the medial surface of the shaft of tibia (superficial to and in front of the gracilis and semitendinosus - S.G.S).
- **Nerve supply:** femoral nerve.
- **Action:** (It acts on both the knee and hip joints).
 1. Flexion, abduction and lateral rotation of the thigh (at the hip joint).
 2. Flexion of the leg (at the knee joint).
- **Important relations of sartorius:**
 1. It is the most superficial muscle in the front of thigh.
 2. Its upper 1/3 (oblique) forms the lateral boundary of the femoral triangle.
 3. Its middle 1/3 (oblique) forms the roof of the adductor canal.
 4. Its lower vertical 1/3 descends along the medial side of popliteal fossa.

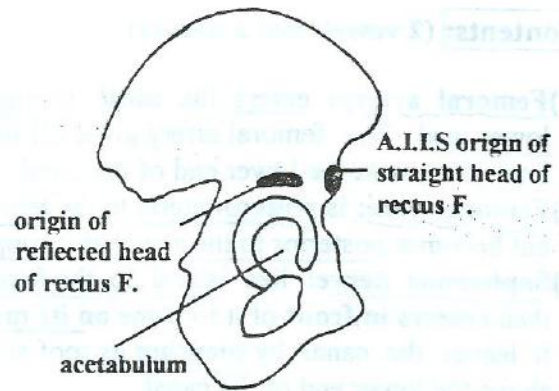


Quadriceps femoris

• Origin:

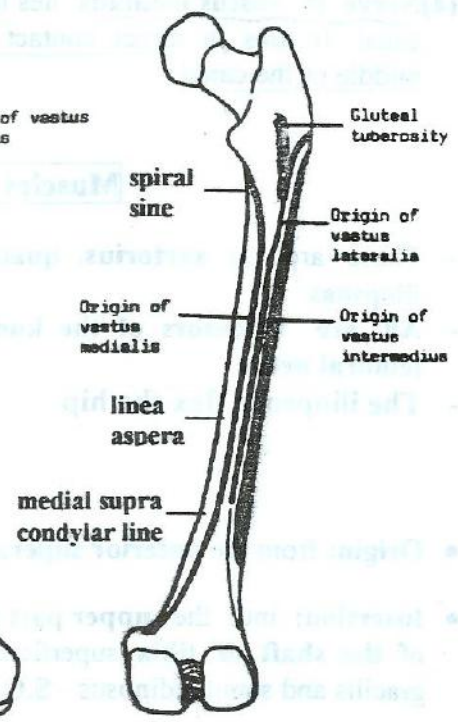
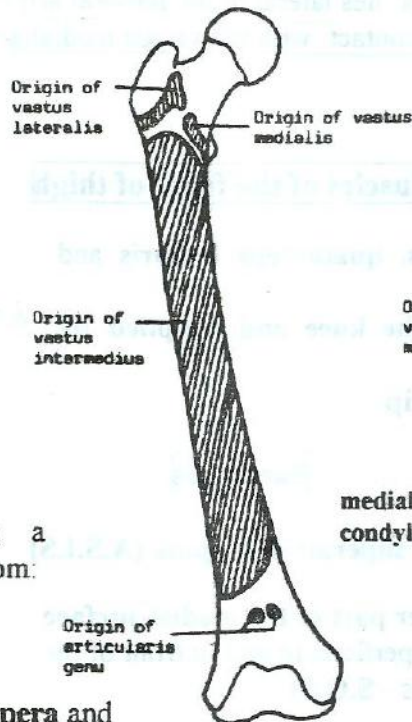
It arises by 4 heads (hence the name quadriceps); these heads are the **rectus femoris** and 3 **vasti**:

1. **Rectus femoris**: arises by 2 heads (straight and reflected):
 - **Straight head**: from the **anterior inferior iliac spine (A.I.I.S)**.
 - **Reflected head**: from an impression just above the **acetabulum**.



2. **Vastus lateralis**: from a continuous line extending from:

- i) the upper part of **intertrochanteric line**
- ii) **root of the greater trochanter**,
- iii) **lateral lip of the gluteal tuberosity** and
- iv) **lateral lip of the linea aspera** (not from the lateral supracondylar line).



ANTERIOR VIEW

POSTERIOR VIEW

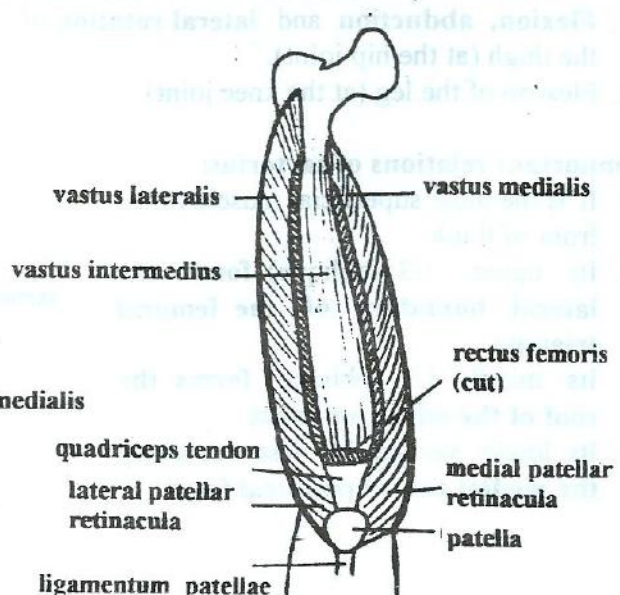
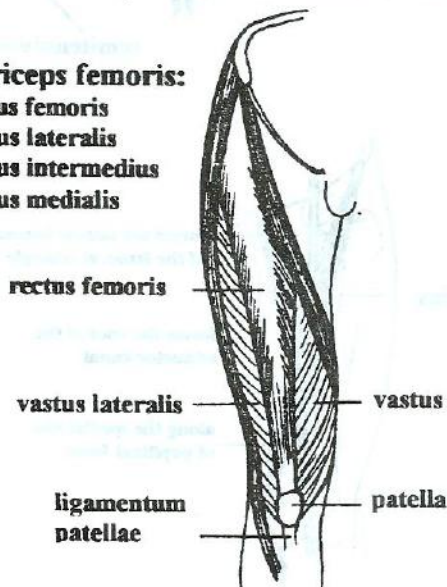
3. **Vastus medialis**: from a continuous line extending from:

- i) the lower part of **intertrochanteric line**,
- ii) **spiral line**,
- iii) **medial lip of the linea aspera** and
- iv) **medial supracondylar line**.

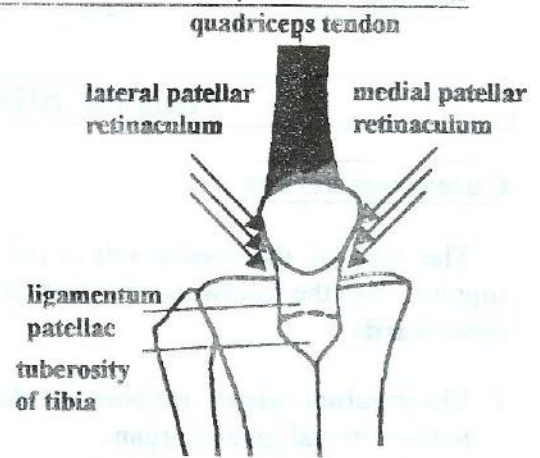
4. **Vastus intermedius**: from the upper 2/3 of the **anterior and lateral surfaces of the femur** (not from the medial surface which is left bare and smooth).

Quadriceps femoris:

1. **rectus femoris**
2. **vastus lateralis**
3. **vastus intermedius**
4. **vastus medialis**



- **Insertion of quadriceps femoris:**
- The four muscles collect into one tendon called *quadriceps tendon* which is inserted into the base of the patella.
- Extensions from the vastus medialis and lateralis reach the medial and lateral sides of the patella. These are known as *medial* and *lateral patellar retinacula*.
- From the apex of the patella the *ligamentum patellae* extends to the tuberosity of the tibia.



- This ligament carries the insertion of the quadriceps to the tibia.

● Nerve supply:

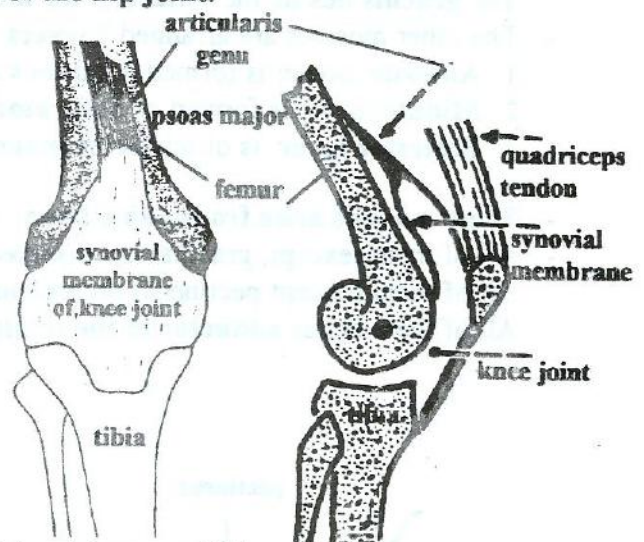
- Each head of the muscle receives a separate branch or branches from the femoral nerve.
- Note that the branches to the rectus femoris supply the hip joint as well.
- While the branches to the 3 vasti supply also the knee joint.

● Action:

1. The muscle as a whole: is the main extensor of the knee joint.
2. The rectus femoris alone: assists in flexion of the hip joint.

Articularis genu muscle

- **Origin:** It is a small slender muscle which arises from the lower part of the anterior surface of femur.
- **Insertion:** Into the synovial membrane of knee joint (supra patellar synovial fold).
- **Nerve supply:** Femoral (from nerve to vastus intermedius).
- **Action:** the articularis genu draws the synovial membrane of the knee joint upwards during extension of the knee (to prevent the membrane from being taken between the articulating bones).



Iliopsoas

The psoas major and iliacus are 2 muscles of the abdomen which fuse together deep to the inguinal ligament to form iliopsoas.

● Origin:

- The psoas major arises from the bodies and transverse processes of all lumbar vertebrae.
- The iliacus arises from the iliac fossa.

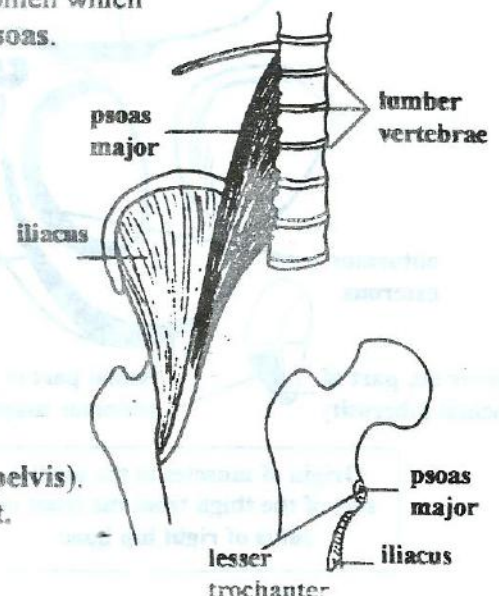
● Insertion:

The 2 muscles is inserted into the lesser trochanter. The iliacus gets further insertion into the femur for a distance of 2.5 cm just below the lesser trochanter.

● Nerve supply:

- Psoas major: by branches from the lumbar plexus (in the abdomen).
- Iliacus: by a branch from the femoral nerve (in the pelvis).

- **Action:** The iliopsoas is the main flexor of the hip joint.

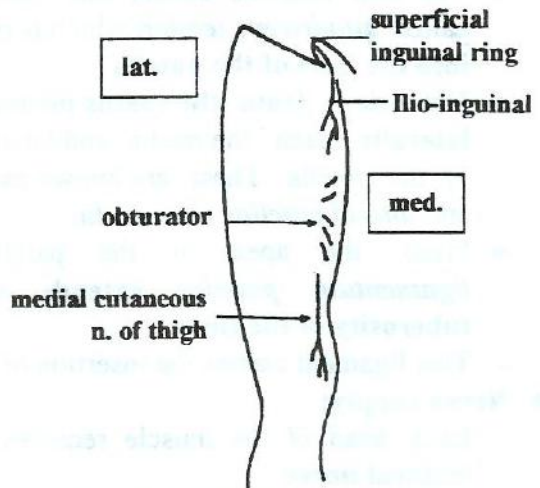


MEDIAL SIDE OF THE THIGH

Cutaneous nerves

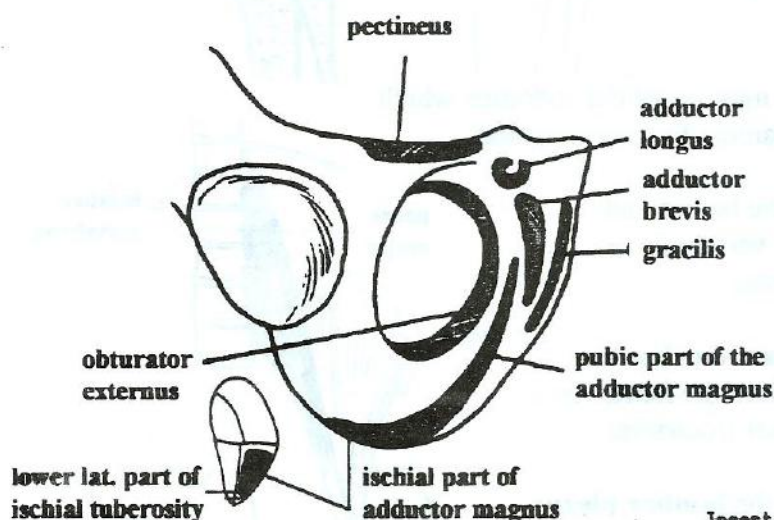
The skin of the medial side of the thigh is supplied by the following nerves from above downwards:

1. **Ilio-inguinal nerve** supplies the skin close to the external genital organs.
2. **Obturator nerve.**
3. **Medial cutaneous nerve of the thigh** (from femoral nerve).

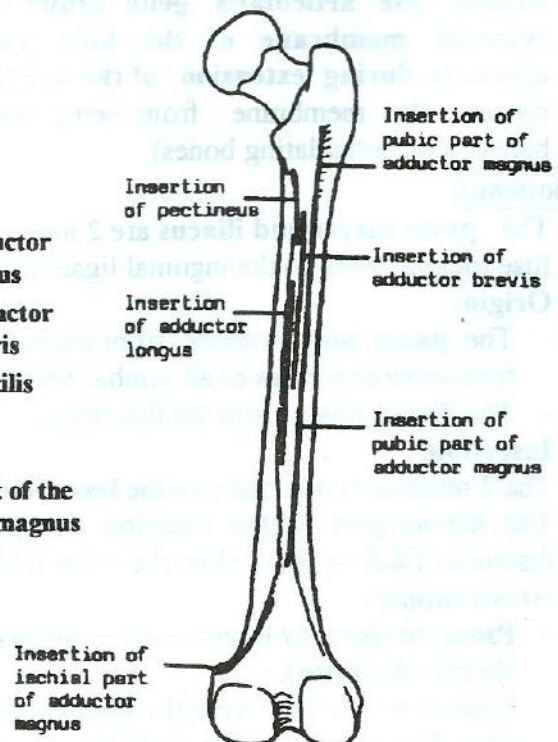


MUSCLES OF THE MEDIAL SIDE OF THE THIGH

- The **gracilis** lies on the surface of the **medial side** of the thigh.
- The other muscles are arranged **3 layers**:
 1. **Anterior layer**: is formed **pectineus** and **adductor longus**.
 2. **Middle layer**: is formed of **obturator externus** and **adductor brevis**.
 3. **Posterior layer**: is of **adductor magnus**.
- These muscles arise from **pubic bone** (body, superior ramus & inferior ramus)
- All of them (except, gracilis) are inserted in the **back of femur**.
- All of them (except pectineus) are supplied by **obturator nerve**.
- All of them act as **adductor** to the thigh.



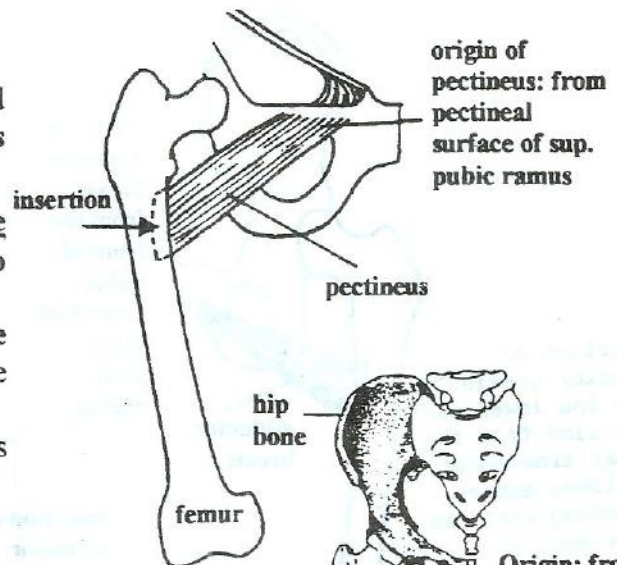
Origin of muscles of the medial side of the thigh from the front of the pubis of right hip bone



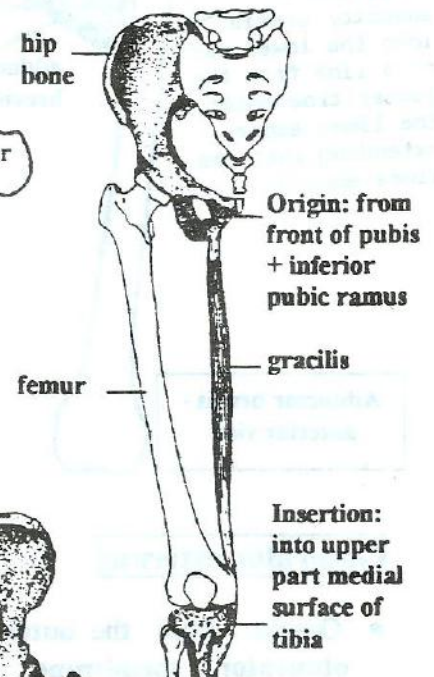
Insertions of muscles of medial side of the thigh into the right femur

Pectineus

- **Origin:** from the pectineal line and pectineal surface of the superior ramus of the pubis.
- **Insertion:** into the upper $\frac{1}{2}$ of a line extending from the lesser trochanter to the linea aspera.
- **Nerve supply:** from the femoral nerve (mainly) in addition to a branch from the obturator nerve (occasionally).
- **Action:** adducts the thigh and assists in its flexion.

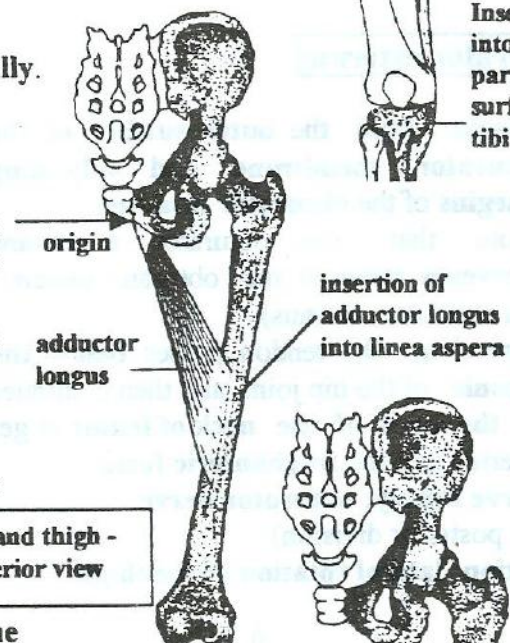
**Gracilis**

- **Origin:** from the front of the body of the pubis and the inferior pubic ramus, close to the symphysis pubis.
- **Insertion:** into the upper part of the medial surface of the tibia (just behind the sartorius).
- **Nerve supply:** obturator nerve.
- **Action:**
 1. Adducts the thigh at the hip joint.
 2. Flexes the knee and rotates the leg medially.

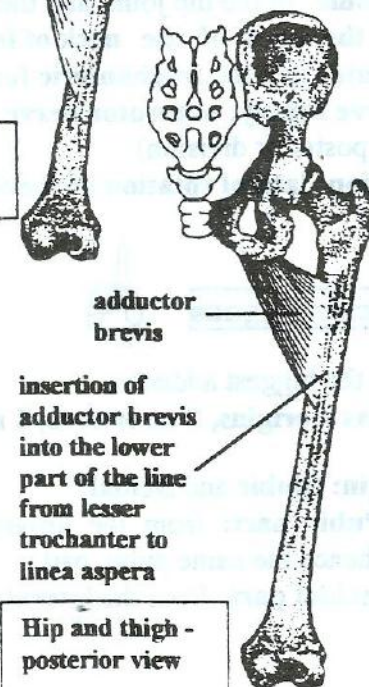
**Adductor longus**

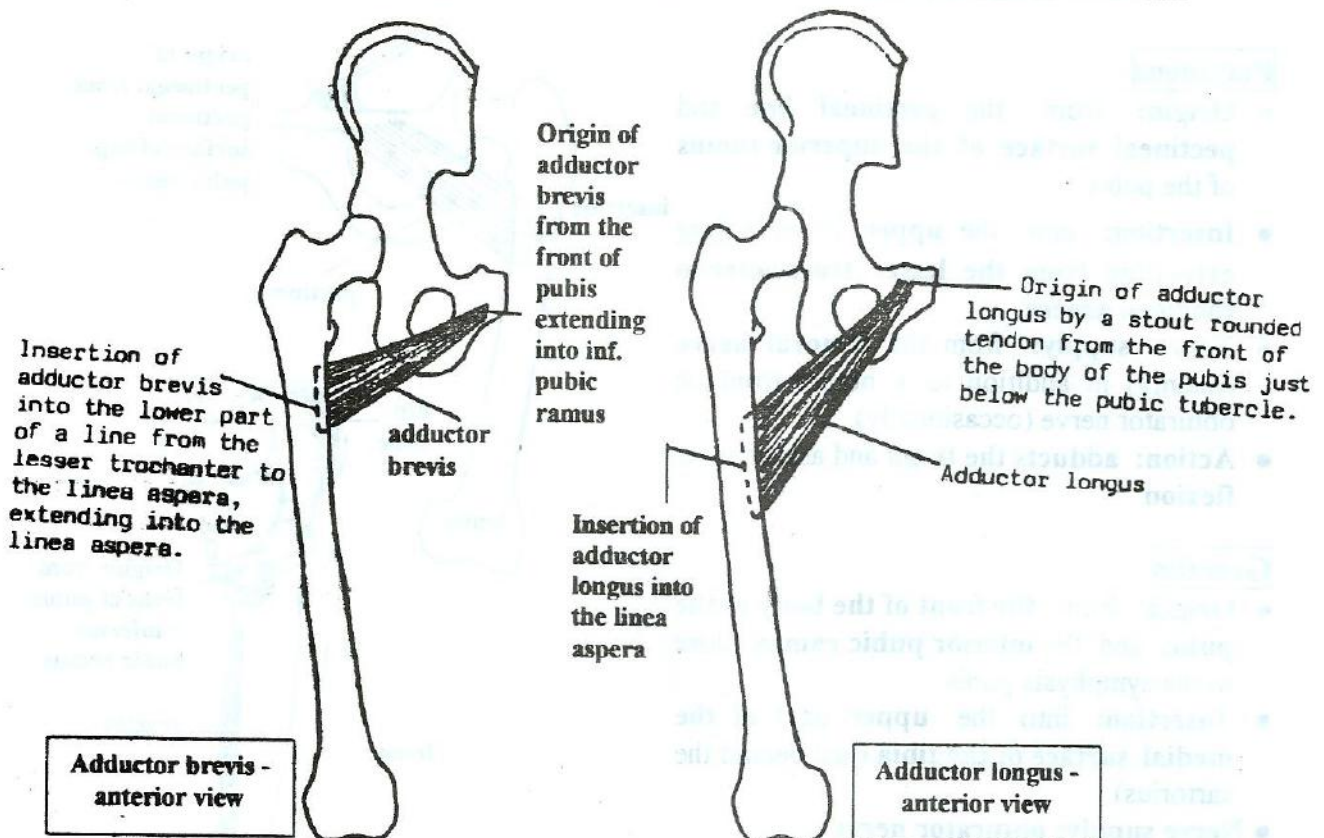
It is the most superficial of the 3 adductors.

- **Origin:** by a rounded tendon from the front of the body of the pubis just below the pubic tubercle.
- **Insertion:** into the middle part of the linea aspera.
- **Nerve supply:** obturator nerve.
- **Action:** Adducts the thigh at the hip and assists in lateral rotation.

**Adductor brevis**

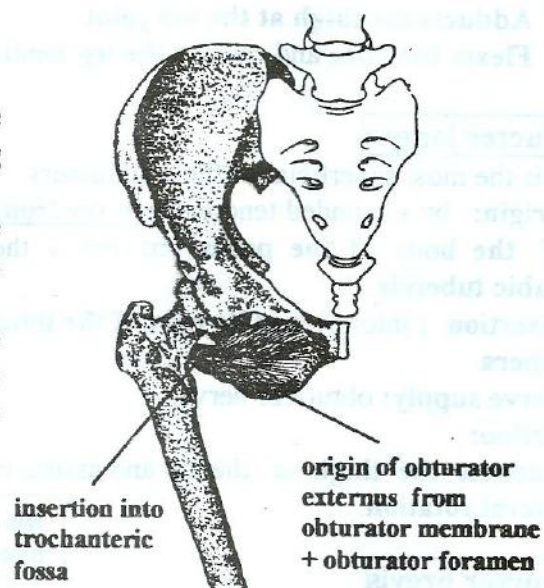
- **Origin:** from the front of the body of the pubis and inferior pubic ramus, just lateral to the gracilis.
- **Insertion:** into the lower part of the line extending from the lesser trochanter to the linea aspera and from the upper part of the linea aspera itself.
- **Nerve supply:** obturator nerve.
- **Action:** Adducts the thigh at the hip and assists in lateral rotation.





Obturator externus

- **Origin:** from the outer surface of the obturator membrane and adjoining margins of the obturator foramen.
(Note that the obturator membrane intervenes between the obturator externus and obturator internus).
- **Insertion:** the tendon passes below the capsule of the hip joint, and then continues on the back of the neck of femur to get inserted into the trochanteric fossa.
- **Nerve supply:** obturator nerve (its posterior division).
- **Action:** lateral rotation of the thigh.



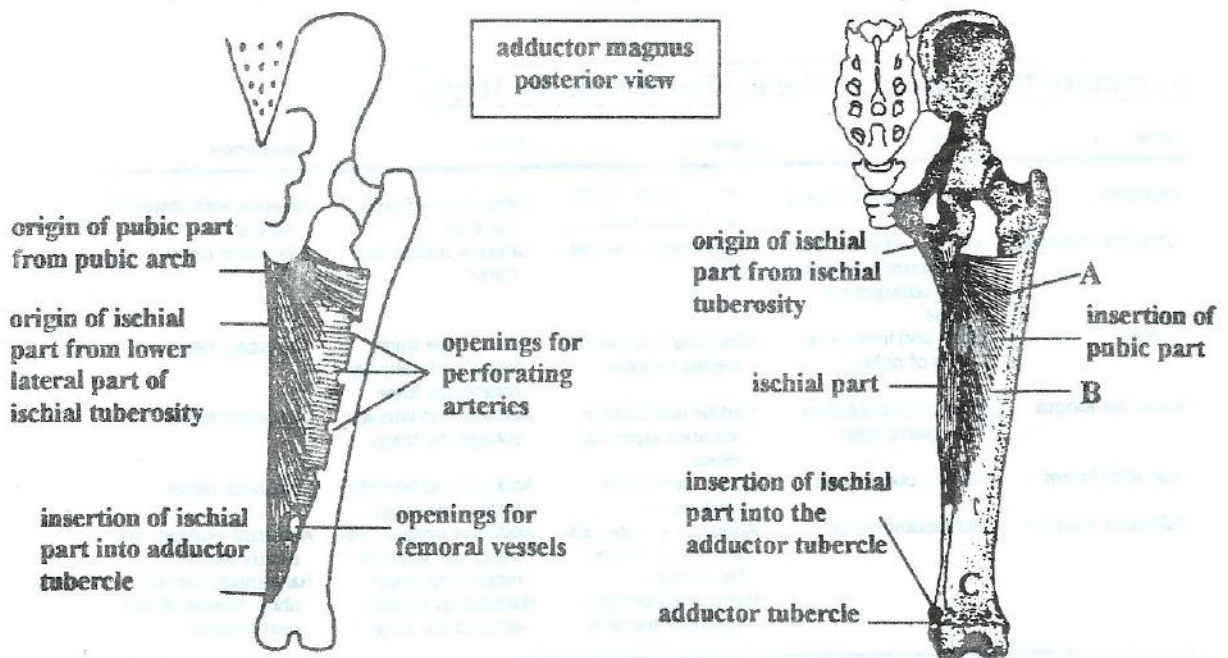
Adductor magnus



It is the biggest adductor.

It has 2 origins, 2 insertions, 2 nerve supply and 2 actions.

- **Origin:** (pubic and ischial).
 1. **Pubic part:** from the anterior surface of the lower part of the pubic arch (hence the name pubic part).
 2. **Ischial part:** from the lateral area of the lower part of the ischial tuberosity.



● **Insertion:**

1. **Pubic part:** is inserted into: (A) medial margin of gluteal tuberosity, (B) linea aspera and (C) medial supracondylar line.
2. **Ischial part:** descends vertically to get insertion into the adductor tubercle of femur.

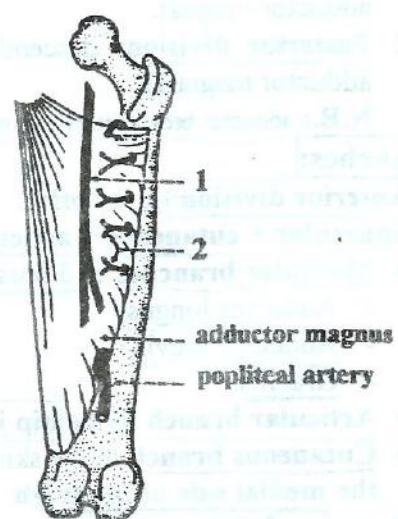
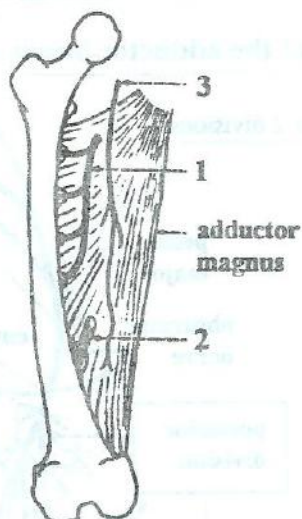
● **Nerve supply:**

1. **Pubic part:** (adductor portion) from the obturator nerve.
2. **Ischial part** (hamstring portion): from the sciatic nerve.

● **Action:**

1. **Pubic part:** strong adductor of the thigh and helps in flexion and lateral rotation of the thigh.
2. **Ischial part** (hamstring portion): extension of the hip joint (like the hamstring muscles).

Main relations:



1. **The anterior surface related to:**

- (1) terminal of part of profunda femoris artery with its perforating branches.
- (2) Femoral artery &
- (3) posterior division of obturator nerve.

2. **The posterior surface related to:**

- (1) sciatic nerve &
- (2) the anastomosis between the perforating arteries.

Summary for muscles of the medial side of the thigh:

NAME	ORIGIN	INSERTION	ACTION	INNERVATION
Pectineus	Pectineal line of pubis	From lesser troch. to linea aspera	Flexes and adducts the thigh	Femoral and obturator nerves
Obturator externus	Lateral surface of the obturator foramen and adjacent hip bone	Trochanteric fossa of femur	Laterally rotates the thigh	Obturator nerve
Gracilis	Body and inferior ramus of pubis	Tibial shaft below the medial condyle	Adducts the thigh; flexes and medially rotates the knee	Obturator nerve
Adductor longus	Body of pubis below the pubic crest	Middle one third of the linea aspera of femur	Adducts and laterally rotates the thigh	Obturator nerve
Adductor brevis	Inferior pubic ramus	Upper part of the linea aspera	Adducts and laterally rotates the thigh	Obturator nerve
Adductor magnus	Isochiopubic ramus	Adductor portion: entire length of the linea aspera Hamstrings portion: adductor tubercle	Adductor portion: adducts and laterally rotates the thigh Hamstrings portion: extends the thigh	Adductor portion: obturator nerve Hamstrings portion: tibial division of the sciatic nerve

Obturator nerve



Origin:

- It arises in the abdomen from the **lumbar plexus**
- from the **ventral divisions** of the anterior primary rami of **L. 2, 3, 4.**

Course and relations:

- It appears at the **medial border of psoas major muscle**.
- It passes on the side of the pelvis in company with the obturator vessels to **enter the obturator canal**.
- Just outside canal (in the thigh) the nerve **divides into 2 divisions** (**anterior and posterior**) as follows:
 - Anterior division:** passes **in front of the adductor brevis** (between it and adductor longus).
 - Posterior division:** descends **behind the adductor brevis** (between it and the adductor magnus).

N.B.: adductor brevis intervenes between the 2 divisions.

Branches:

a. Anterior division: gives off:

(**muscular + cutaneous + articular**)

- Muscular branches to 3 muscles:**
 - Adductor longus.
 - Adductor brevis.
 - Gracilis.

- Articular branch to the hip joint.**

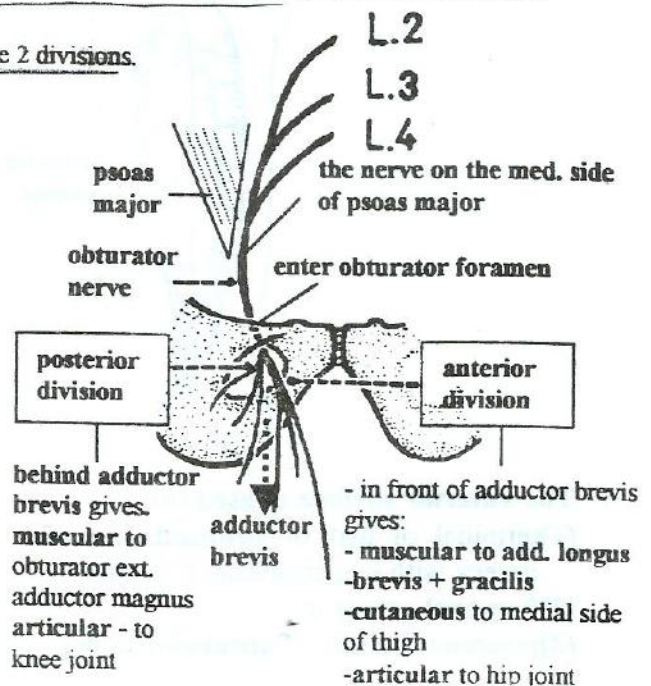
- Cutaneous branch to the skin of the medial side of the thigh.**

b. Posterior division: gives off:

(**muscular + articular**)

- Muscular branches to 2 muscles:**
 - Obturator externus.
 - Adductor magnus (pubic part).

- Articular branch to the knee joint**

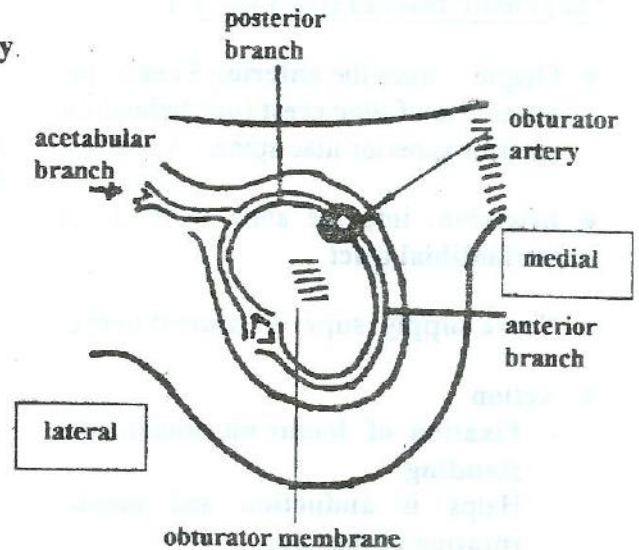


The obturator artery

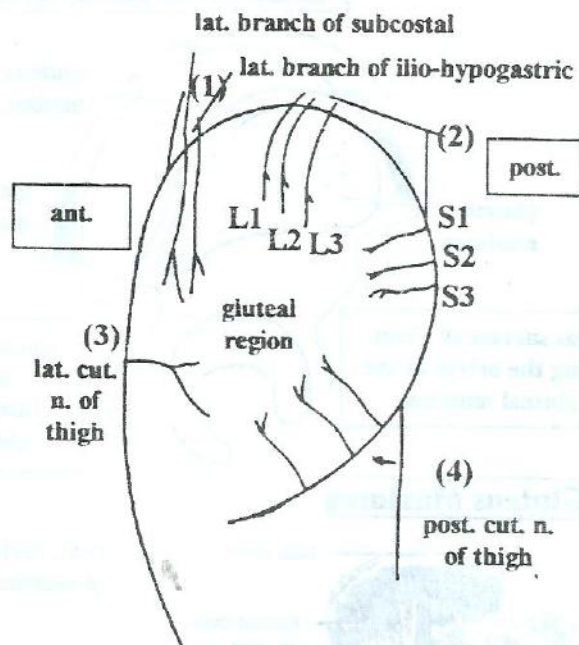
- It arises in the pelvis from **internal iliac artery**.
- It enters the thigh by passing through the **obturator canal**.
- It divides into 2 branches (**anterior & posterior**) which form a circle on the outer surface of obturator membrane.

Branches:

1. **Acetabular branch**, which reaches the hip joint through the acetabular foramen. This branch gives twigs, which passes along the ligament of the head of femur to supply the head of femur.
2. **Muscular branches** to the muscles of the medial side of the thigh.

**GLUTEAL REGION****Cutaneous Nerve Supply**

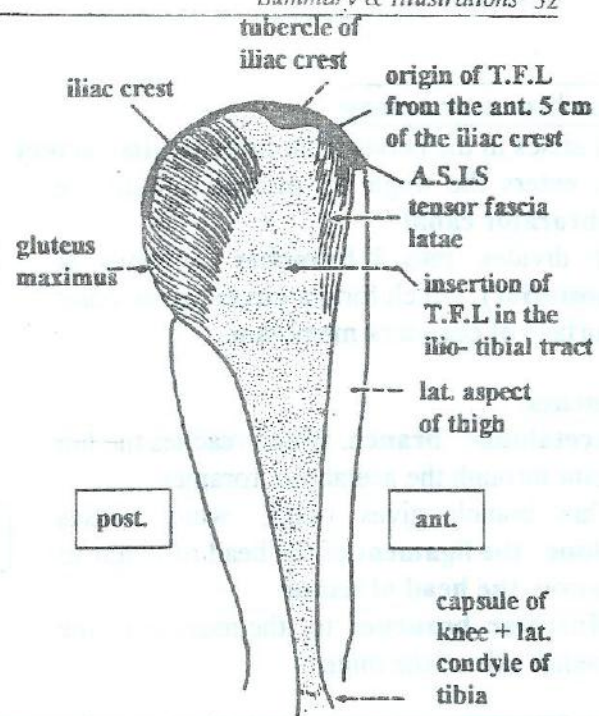
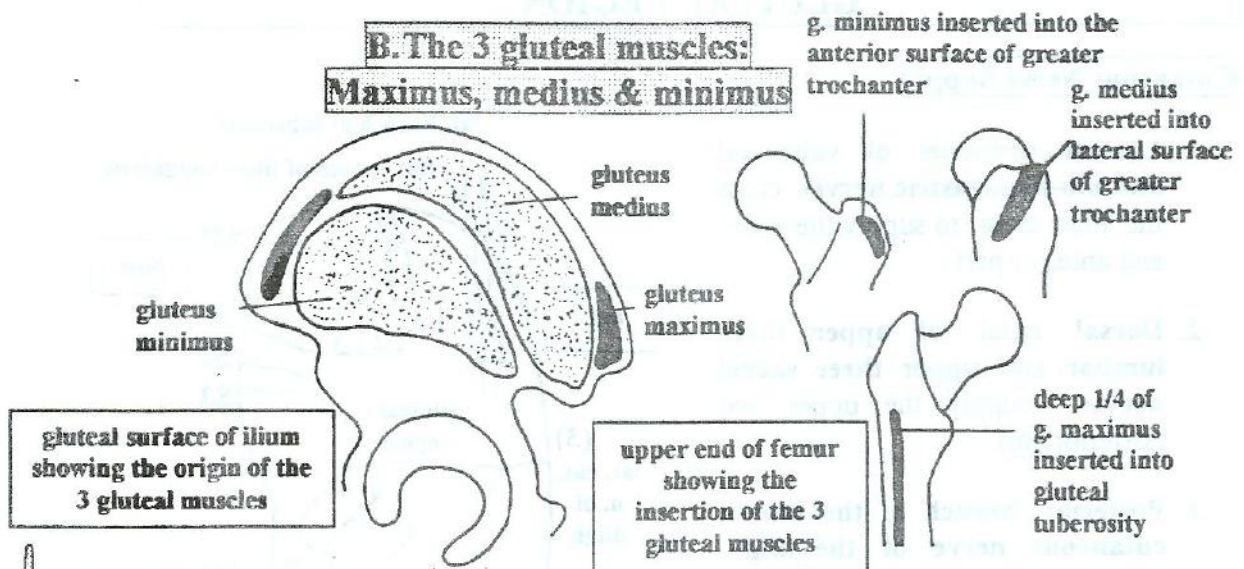
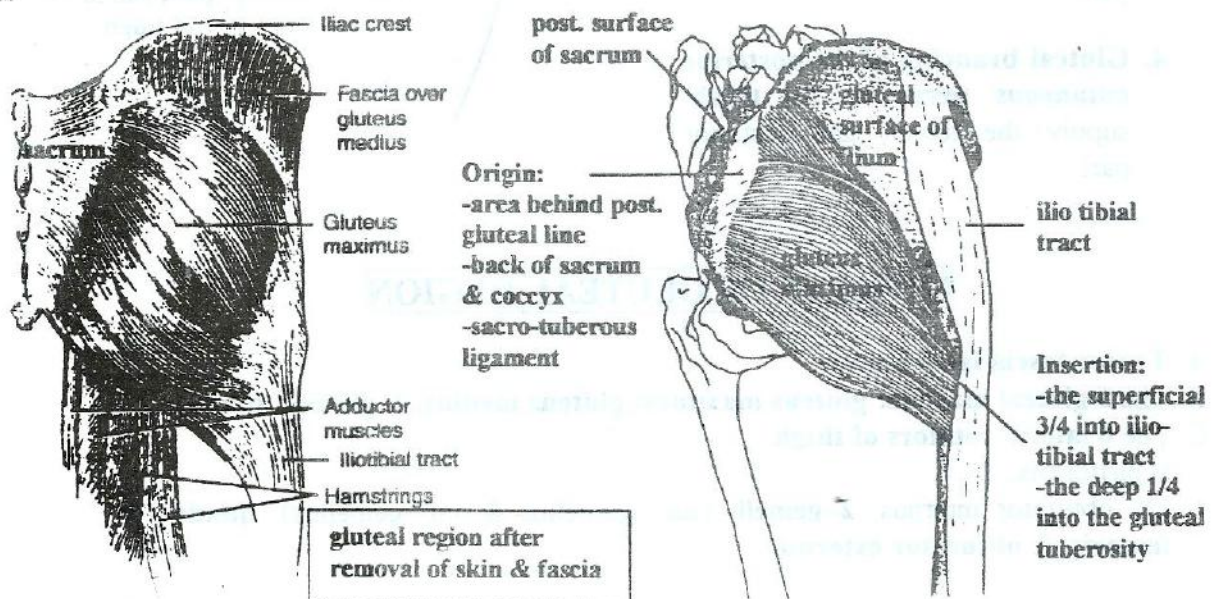
1. **Lateral branches of subcostal and ilio-hypogastric nerves**: cross the iliac crest to supply the upper and anterior part.
2. **Dorsal rami of upper three lumbar and upper three sacral nerves**: supply the upper and posterior part.
3. **Posterior branch of the lateral cutaneous nerve of the thigh**: supplies the lower and anterior part.
4. **Gluteal branches of the posterior cutaneous nerve of the thigh**: supply the lower and posterior part.

**MUSCLES OF GLUTEAL REGION**

- A. **Tensor fascia latae muscle.**
- B. **The 3 gluteal muscles: gluteus maximus, gluteus medius, & gluteus minimus.**
- C. **The 6 lateral rotators of thigh:**
 - i) piriformis,
 - ii) obturator internus, 2 gemelli (sup. gemellus & inf. gemellus), quadratus femoris, & obturator externus.

A. Tensor fascia latae (T.F.L)

- **Origin:** from the anterior 5 cm of the outer lip of iliac crest (just behind the anterior superior iliac spine - A.S.I.S).
- **Insertion:** into the anterior border of the iliotibial tract.
- **Nerve supply:** superior gluteal nerve.
- **Action:**
 - Fixation of femur on tibia during standing.
 - Helps in abduction and medial rotation of the thigh.

**B. The 3 gluteal muscles: Maximus, medius & minimus****Gluteus Maximus**

● **Origin:**

1. From the gluteal surface of the ilium behind the posterior gluteal line.
2. From the back of the sacrum
3. From the back of the sacro-tuberous ligament.

● **Insertion:**

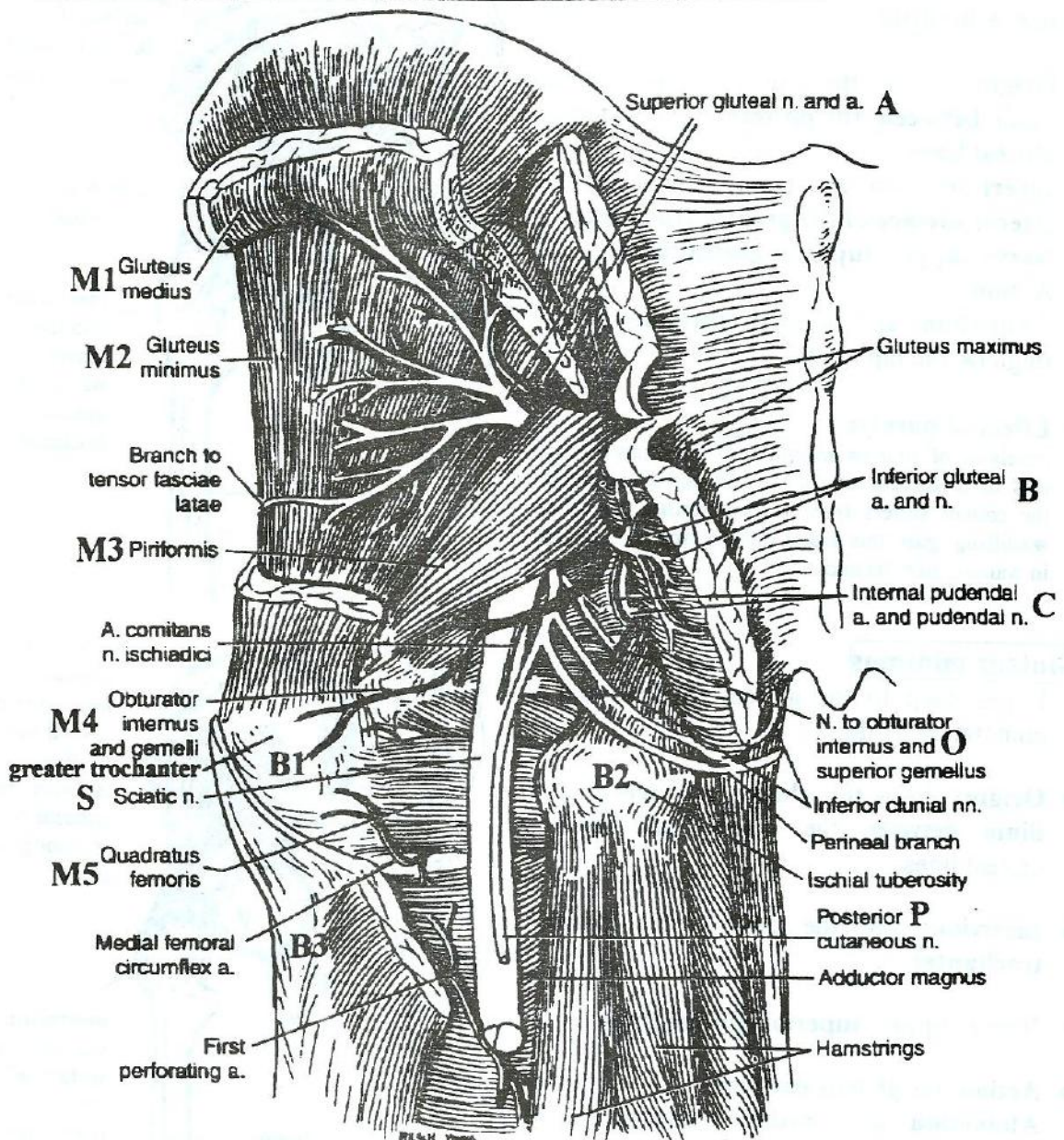
1. Its superficial 3/4: into the posterior border of the ilio-tibial tract.
2. Its deep 1/4: into the gluteal tuberosity

● **Nerve supply:** inferior gluteal nerve

● **Action:**

1. It is the main extensor of the hip joint
2. Through tightening the iliotibial tract, thus helping to extend the knee & steady femur in tibia.
4. It is a strong lateral rotator and abductor of thigh

Structure undercover of Gluteus maximus (deep relations)



1. **Bony parts:**

- greater trochanter & ischial tuberosity.

2. **Ligaments:**

- Sacro-tuberous ligament.
- Sacro-spinous ligament.

3. Muscles:

- Gluteus medius (M1).
- Gluteus minimus (M2) hidden by gluteus medius.
- Piriformis (M3).
- Tendon of obturator internus and 2 gemelli (M4).
- Quadratus femoris (M5).

4. Vessels:

- Superior(A) and inferior gluteal vessels(B).
- Internal pudendal vessels(C).

5. Nerves:

- Sciatic nerve(S).
- Superior(A) and inferior gluteal(B) nerves.
- Posterior cutaneous nerve of thigh(P).
- Pudendal nerve(C).
- Nerve to obturator internus(O).
- Nerve to quadratus femoris.

6. Bursae:

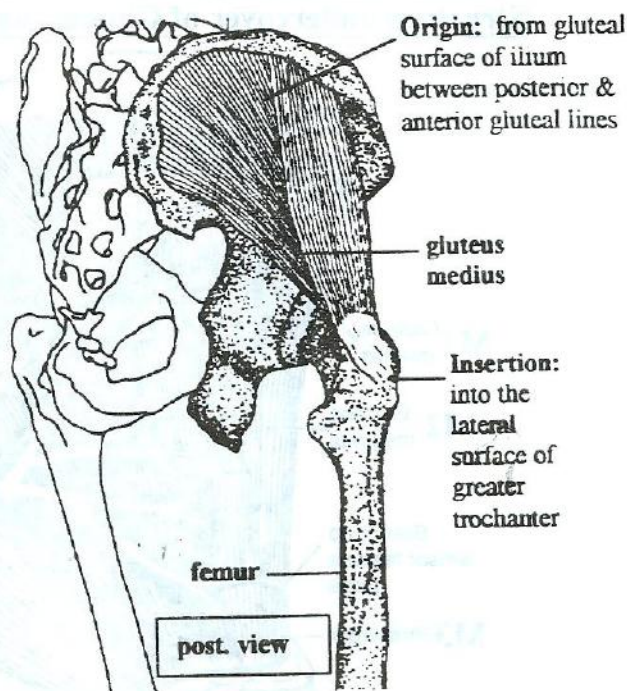
- One on the ischial tuberosity(B1).
- One on the greater trochanter(B2).
- One on the vastus lateralis(B3).

Gluteus medius

- **Origin:** from the gluteal surface of the ilium **between the posterior and anterior gluteal lines.**
- **Insertion:** into the oblique ridge on the lateral surface of the greater trochanter.
- **Nerve supply:** superior gluteal nerve.
- **Action:** Abduction and medial rotation of the thigh (at the hip joint).

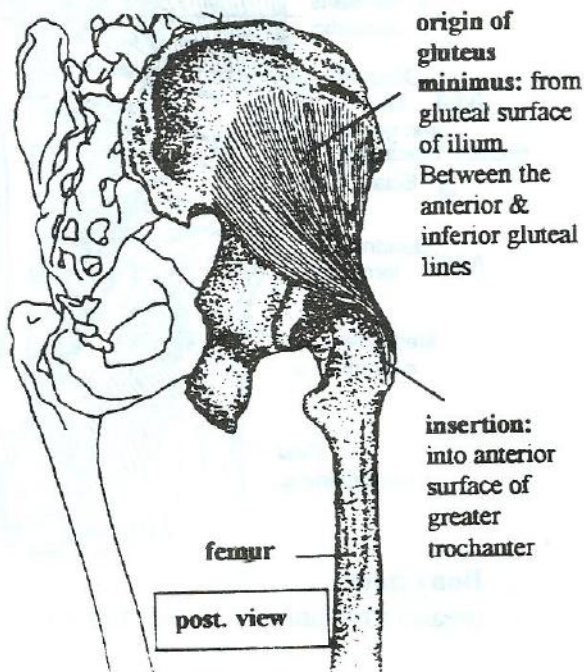
• **Effect of paralysis:**

Paralysis of gluteus medius and minimus leads to loss of abduction of the hip joint and consequently the patient suffers from a characteristic gait called **waddling gait** (this means moving from side to side in walking like the duck).

**Gluteus minimus**

It lies deep to the gluteus medius and is completely hidden by it.

- **Origin:** from the gluteal surface of the ilium between the anterior and inferior gluteal lines.
- **Insertion:** into the front of the greater trochanter.
- **Nerve supply:** superior gluteal nerve.
- **Action:** (as gluteus medius). Abduction and medial rotation of the thigh (at the hip joint).

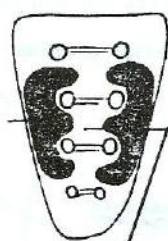


The 6 lateral Rotators of the hip

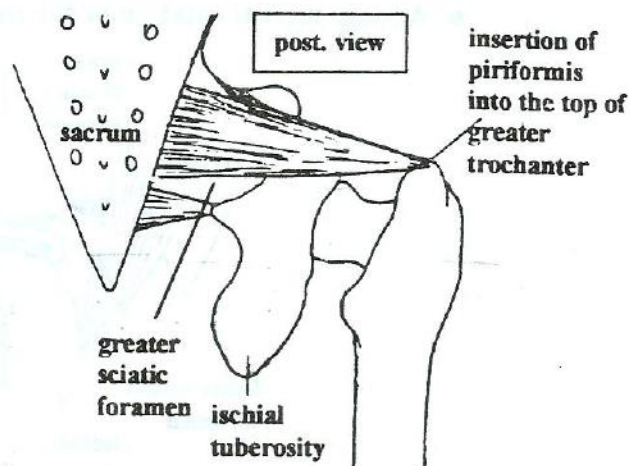
Piriformis, obturator internus, superior, inferior gemelli, quadratus femoris & obturator externus.

Piriformis

- **Origin:** from the anterior (pelvic) surface of the middle 3 pieces of the sacrum.
- **Insertion:** the muscle passes through the greater sciatic foramen and is inserted into the top of the greater trochanter.
- **Nerve supply:** branches from the sacral plexus twigs from (S1 & 2).
- **Action:** rotates the thigh laterally.



anterior (pelvic) surface of sacrum showing the origin of piriformis



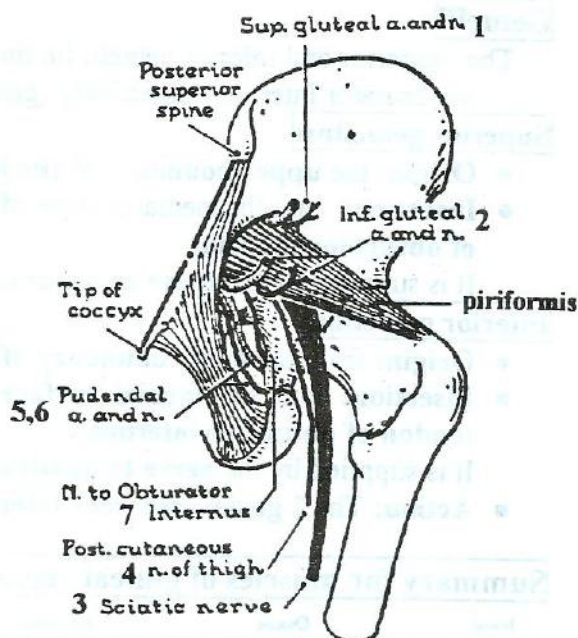
Relations:

Above the muscle:

- Superior gluteal nerve and vessels(1).

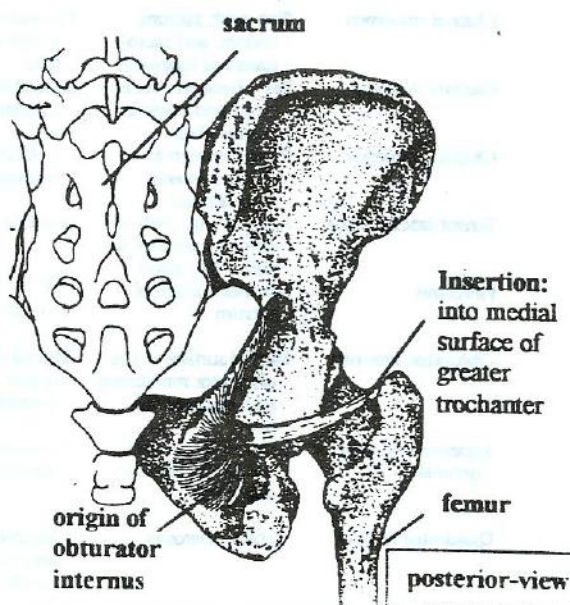
Below the muscle:

- Inferior gluteal nerve and vessels(2).
- Sciatic nerve(3).
- Posterior cutaneous nerve of thigh(4).
- The 3 structures passing from the greater to the lesser sciatic foramina: pudendal nerve(5), internal pudendal artery(6) and nerve to obturator internus(7).



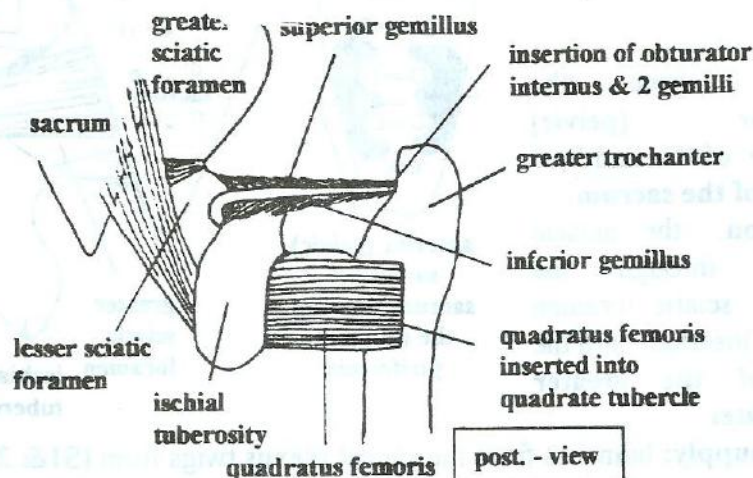
Obturator internus

- **Origin:**
 1. from the inner surface of the obturator foramen.
 2. From the margins of obturator foramen.
 3. Pelvic surface of ilium & ischium.
- **Insertion:** its tendon leaves the pelvis through the lesser sciatic foramen to get insertion into the medial surface of the greater trochanter.
- **Nerve supply:** nerve to obturator internus (from the sacral plexus) (L5, S1, 2 & S3).
- **Action:** it is a main lateral rotator of the thigh (at the hip joint).



Quadratus femoris

- **Origin:** from the lateral margin sacrum of the ischial tuberosity.
- **Insertion:** into the quadrate tubercle on the intertrochanteric crest.
- **Nerve supply:** nerve to quadratus femoris (from the sacral plexus).
- **Action:** lateral rotation of the thigh (at the hip join).

**Gemelli**

The superior and inferior gemelli lie on the upper and lower margins of the tendon of obturator internus respectively (gemelli = twins).

Superior gemellus:

- **Origin:** the upper boundary of the lesser sciatic notch.
- **Insertion:** into the medial surface of the greater trochanter and into the tendon of obturator internus.

It is supplied by the nerve to obturator internus.

Inferior gemellus:

- **Origin:** from the lower boundary of the lesser sciatic notch.
- **Insertion:** into the medial surface of the greater trochanter and into the tendon of obturator internus.

It is supplied by the nerve to quadratus femoris.

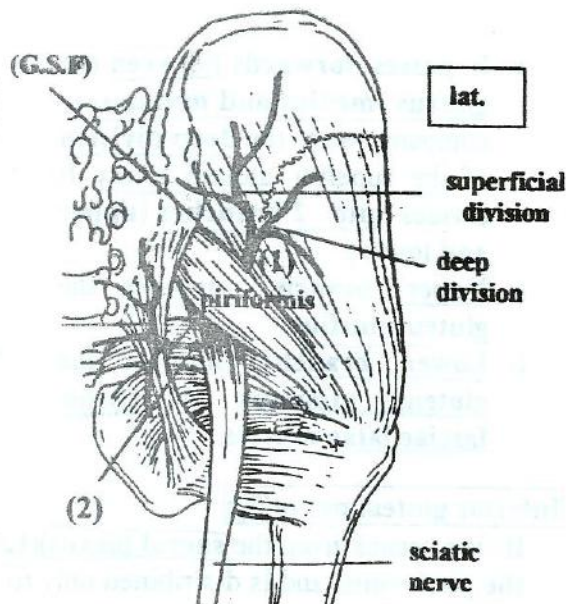
- **Action:** The 2 gemelli are weak lateral rotators of the thigh.

Summary for muscles of gluteal region:

NAME	ORIGIN	INSERTION	ACTION	INNERVATION
Gluteus maximus	Iliac crest, sacrum, coccyx, and sacrotuberous ligament	Gluteal tuberosity of femur and iliotibial tract	Extends and laterally rotates the thigh	Inferior gluteal nerve
Gluteus medius	Ilium between the anterior and posterior gluteal lines	Lateral side of greater trochanter of femur	Abducts and medially rotates the thigh	Superior gluteal nerve
Gluteus minimus	Ilium between anterior and inferior gluteal lines	Front of greater trochanter of femur	Abducts and medially rotates the thigh	Superior gluteal nerve
Tensor fasciae latae	Anterior iliac crest behind the anterior superior iliac spine	Iliotibial tract	Flexes, abducts, and medially rotates the thigh	Superior gluteal nerve
Piriformis	Anterior surface of sacrum	Top of greater trochanter	Laterally rotates the thigh	Branches of the S1 and S2 root
Obturator internus	Medial surface of the obturator foramen and adjacent hip bone	Medial side of the upper end of the greater trochanter	Laterally rotates the thigh	Nerve to the obturator internus
Superior and inferior gemelli	Ischium above and below the lesser sciatic notch	Obturator internus tendon	Laterally rotates the thigh	Superior: nerve to obturator internus Inferior: nerve to quadratus femoris
Quadratus femoris	Ischial tuberosity	Intertrochanteric crest and quadrate tubercle of femur	Laterally rotates the thigh	Nerve to quadratus femoris

Arteries of gluteal region**Superior gluteal artery(1):**

- It is a branch from the posterior division of the internal iliac artery.
- It reaches the gluteal region by passing through the greater sciatic foramen (G.S.F) above the piriformis where it divides into superficial and deep divisions:
 - a. Superficial division: enters the deep surface of gluteus maximus.
 - b. Deep division: passes forwards between the gluteus medius and gluteus minimus in company with the superior gluteal nerve.

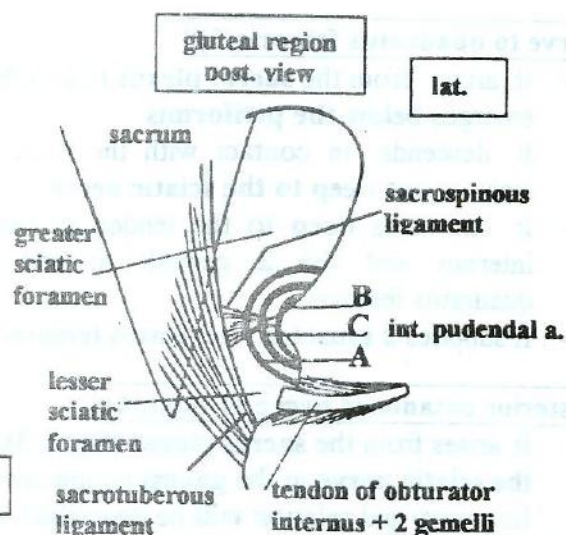
**Inferior gluteal artery(2):**

- It is a branch from the anterior division of the internal iliac artery.
- It leaves the pelvis through the greater sciatic foramen below the piriformis.
- It supplies the gluteus maximus and gives the following branches:
 - a. Accompanying branch to the sciatic nerve (sciatic artery): runs in contact with the nerve and then pierces its substance.
 - b. Anastomotic branch: which descends to join the cruciate anastomosis.

Internal pudendal artery(C):

(will be described in detail in pelvis).

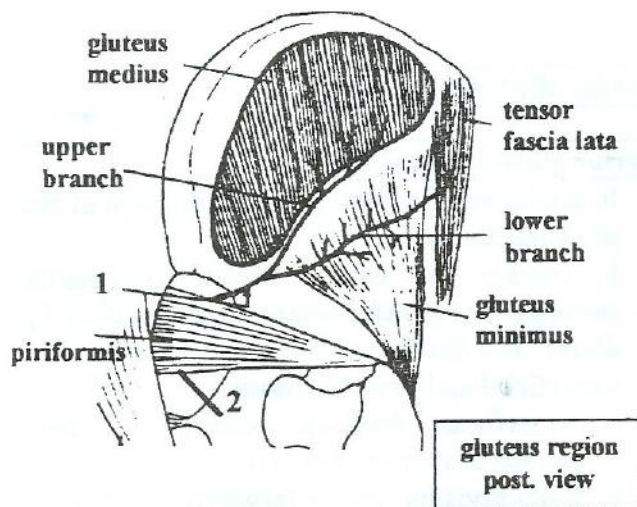
- It is a branch from the anterior division of the internal iliac artery.
- It leaves the pelvis through the greater sciatic foramen below the piriformis.
- It has a very short course in the gluteal region, as it rapidly enters the lesser sciatic foramen together with the pudendal nerve and nerve to obturator internus in the following arrangement:
 - Pudendal nerve(A): is the medial structure. It crosses the sacro-spinous ligament.
 - Nerve to obturator internus(B): is the lateral structure. It crosses the base of the ischial spine.
 - Internal pudendal artery(C): is the intermediate structure (between the 2 nerves). It crosses the tip of the ischial spine.

**Nerves of gluteal region****→ Superior gluteal nerve(1):**

- It is a branch from the sacral plexus (L. 4, 5, S1).
- It appears in the gluteal region above the piriformis in company with the superior gluteal vessels.

- It passes forwards between the gluteus medius and minimus in company with the deep division of the superior gluteal artery. It divides into 2 branches (upper and lower):

- a. Upper branch: supplies the gluteus medius.
- b. Lower branch: supplies the gluteus minimus and tensor fasciae latae muscle.



Inferior gluteal nerve(2):

It is a branch from the sacral plexus (L5, S1, 2). It enters the gluteal region below the piriformis, and is distributed only to the gluteus maximus.

Pudendal nerve(3):

It is a branch from the sacral plexus (S2,3,4). It leaves the pelvis below the piriformis and crosses the back of the sacro-spinous ligament to enter the lesser sciatic foramen. It is the nerve that supplies the skin and muscles of the perineum including the external genital organs.

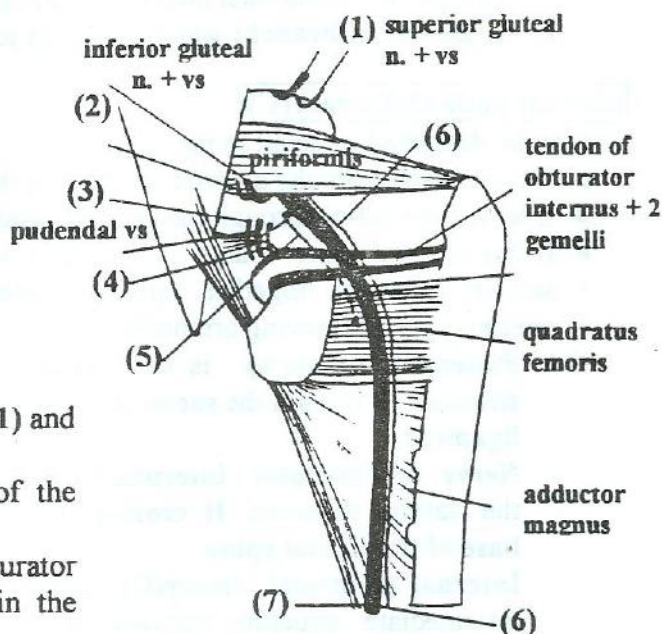
Nerve to obturator internus(4):

It arises from the sacral plexus (L5, S1, 2) and accompanies the pudendal nerve and internal pudendal artery and pass from the greater sciatic foramen to the lesser sciatic foramen.

It supplies 2 muscles: obturator internus and superior gemellus.

Nerve to quadratus femoris(5):

- It arises from the sacral plexus (L4, 5, S1) and emerges below the piriformis.
- It descends in contact with the back of the ischium and deep to the sciatic nerve.
- It continues deep to the tendon of obturator internus and the 2 gemelli to end in the quadratus femoris.
- It supplies 2 muscles: quadratus femoris and inferior gemellus.



Posterior cutaneous nerve of thigh(6):

- It arises from the sacral plexus (S1, 2, 3). It descends alongside (superficial to the sciatic nerve) in the gluteal region under cover of the gluteus maximus.
- Its course and relation will be described with the back of the thigh.

Sciatic nerve(7):

- It is formed in the pelvis from the sacral plexus (L 4,5 S 1,2,3).
- It leaves the pelvis by passing through the greater sciatic foramen below the piriformis to enter the gluteal region and the back of thigh.
- Its course and relation will be described with the back of the thigh.

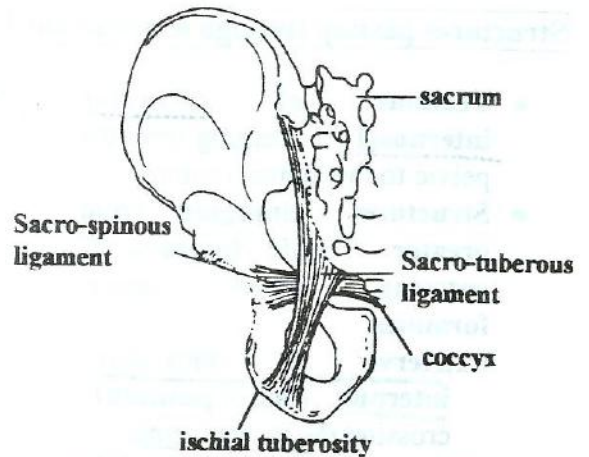
Ligaments of gluteal region

1. Sacro-tuberous ligament:

- It extends from the ischial tuberosity to the lateral margin of the sacrum and coccyx.

2. Sacro-spinous ligament:

- It extends from the spine of the ischium to the last piece of sacrum and the 1st piece of coccyx.



N.B.: The sacro-spinous & sacro-tuberous ligaments convert the:

Greater sciatic notch into → greater sciatic foramen.
 lesser sciatic notch into → lesser sciatic foramen.

→ Foramina of the gluteal region

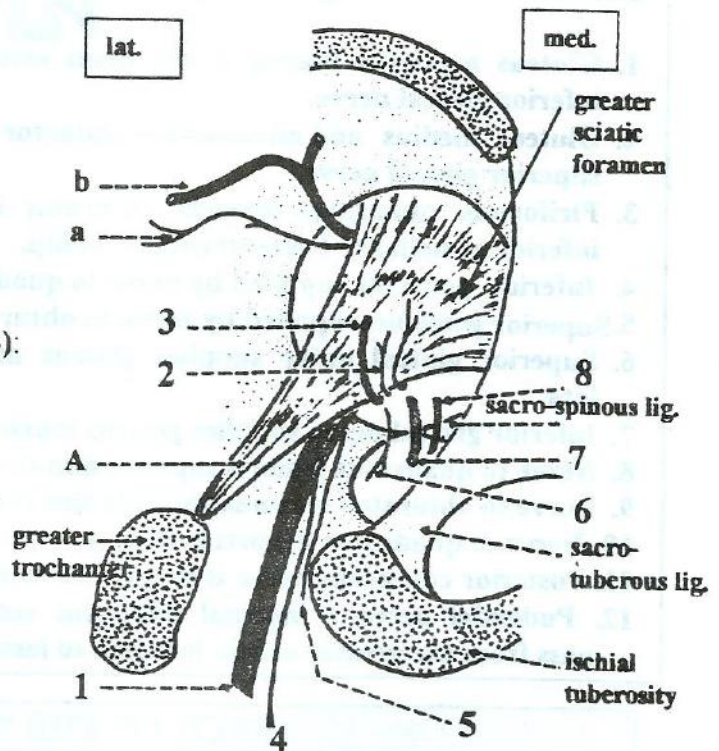
Greater sciatic foramen

Boundaries:

1. greater sciatic notch.
2. sacro-spinous ligament.
3. Sacro-tuberous ligament.

Structures passing through it:

- piriformis muscle(A).
- structures above the piriformis(B):
 - a. superior gluteal nerve.
 - b. superior gluteal vessels.
- structures below the piriformis.
 1. Sciatic nerve.
 2. Inferior gluteal nerve.
 3. inferior gluteal vessels.
 4. Post. cut. n. of the thigh.
 5. n. to quadratus femoris.
 6. n. to obturator internus.
 7. internal pudendal vessels.
 8. pudendal nerve.



(N.B. The last 3 structures (6,7,8) pass from the greater sciatic foramen to the lesser sciatic foramen)

Lesser sciatic foramen:

Boundaries:

1. lesser sciatic notch.
2. sacro-spinous ligament.
3. sacro-tuberous ligament.

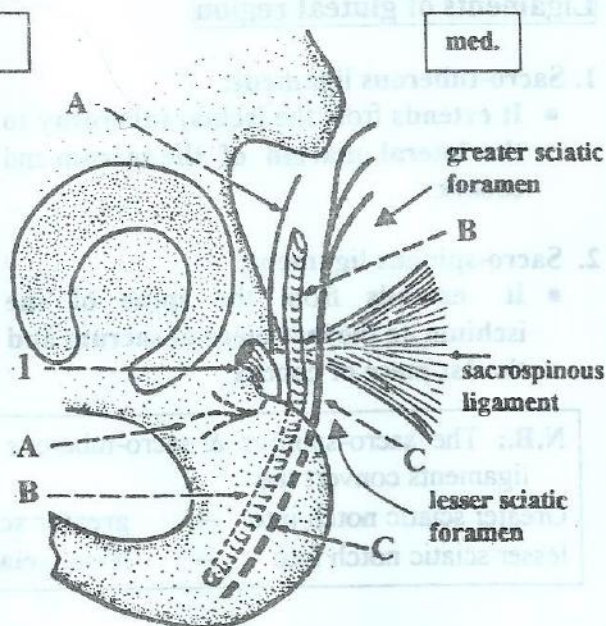
Structures passing through lesser sciatic foramen:

- **Tendons of obturator internus(1):** emerging from the pelvic to the gluteal region.
- **Structures emerging from greater sciatic foramen & entering lesser sciatic foramen.**

(A) **Nerve to obturator internus:** (lat. in position) crossing the ischial spine.

(B) **Internal pudendal vessels:** (intermediate in position) crossing tip of ischial spine.

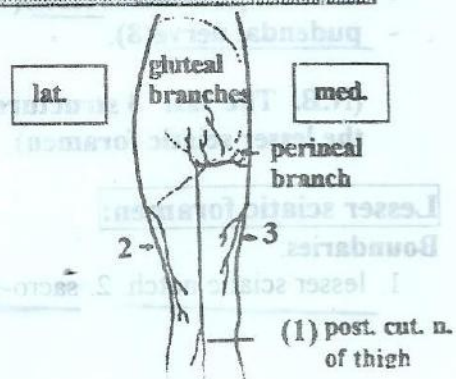
(C) **Pudendal nerve:** (medial in position) crossing the sacro-spinous ligament.

**Remember that about gluteal region**

1. Gluteus maximus muscle is the main extensor of the hip, and supplied by inferior gluteal nerve.
2. Gluteus medius and minimus are abductor & medial rotator and supplied by superior gluteal nerve.
3. Piriformis, quadratus femoris, obturator internus & externus, superior & inferior gemelli are 6 lateral rotator to hip.
4. Inferior gemellus supplied by nerve to quadratus femoris.
5. Superior gemellus supplied by nerve to obturator internus.
6. Superior gluteal nerve supplies gluteus medius and minimus + tensor fascia lata.
7. Inferior gluteal nerve supplies gluteus maximus only.
8. Nerve to quadratus femoris supplies also the inferior gemellus muscle.
9. Nerve to obturator internus supplies also the superior gemellus muscle.
10. Nerve to quadratus femoris is deep to sciatic nerve.
11. Posterior cutaneous nerve is superficial to sciatic nerve.
12. Pudendal nerve + internal pudendal vessels + nerve to obturator internus pass from the greater sciatic foramen to lesser sciatic foramen.

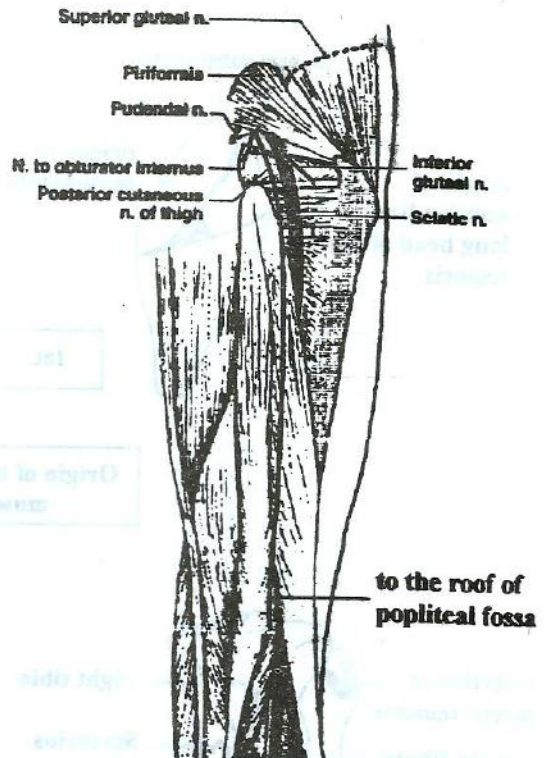
BACK OF THE THIGH**Cutaneous nerve supplies**

- Posterior cutaneous nerve of the thigh(1).
- Posterior branch of the lateral cutaneous nerve of the thigh(2).
- Posterior branch of the medial cutaneous nerve of the thigh(3).



Posterior cutaneous nerve of thigh:

- It arises from the **sacral plexus (S1, 2, 3)**.
- It descends alongside (superficial to) the sciatic nerve in the gluteal region under cover of the gluteus maximus.
- It descends **in the midline** of the back of thigh, immediately beneath deep fascia.
- It continues **in the roof** of the popliteal fossa and ends half-way the back of leg.
- It gives off the following **branches**:
 1. **Gluteal branches**: to the skin of the lower part of the buttock.
 2. **Perineal branch**: to the skin of the perineum.
 3. Branches to the skin of the back of thigh and roof of popliteal fossa.
 4. Branches to the skin of the upper 1/2 of the calf of the leg.



The back of the thigh contains:

1. Hamstring muscles.
2. Sciatic nerve.
3. A long chain of anastomosis (between the perforating arteries) as well as the **cruciate anastomosis**.

Hamstring muscles

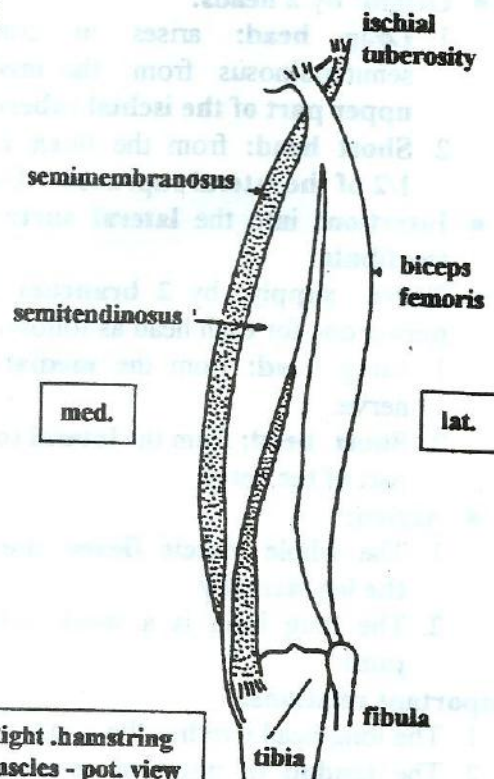
These muscles are called "hamstrings" because their tendons bound the popliteal fossa (ham = popliteal fossa; string = tendon).

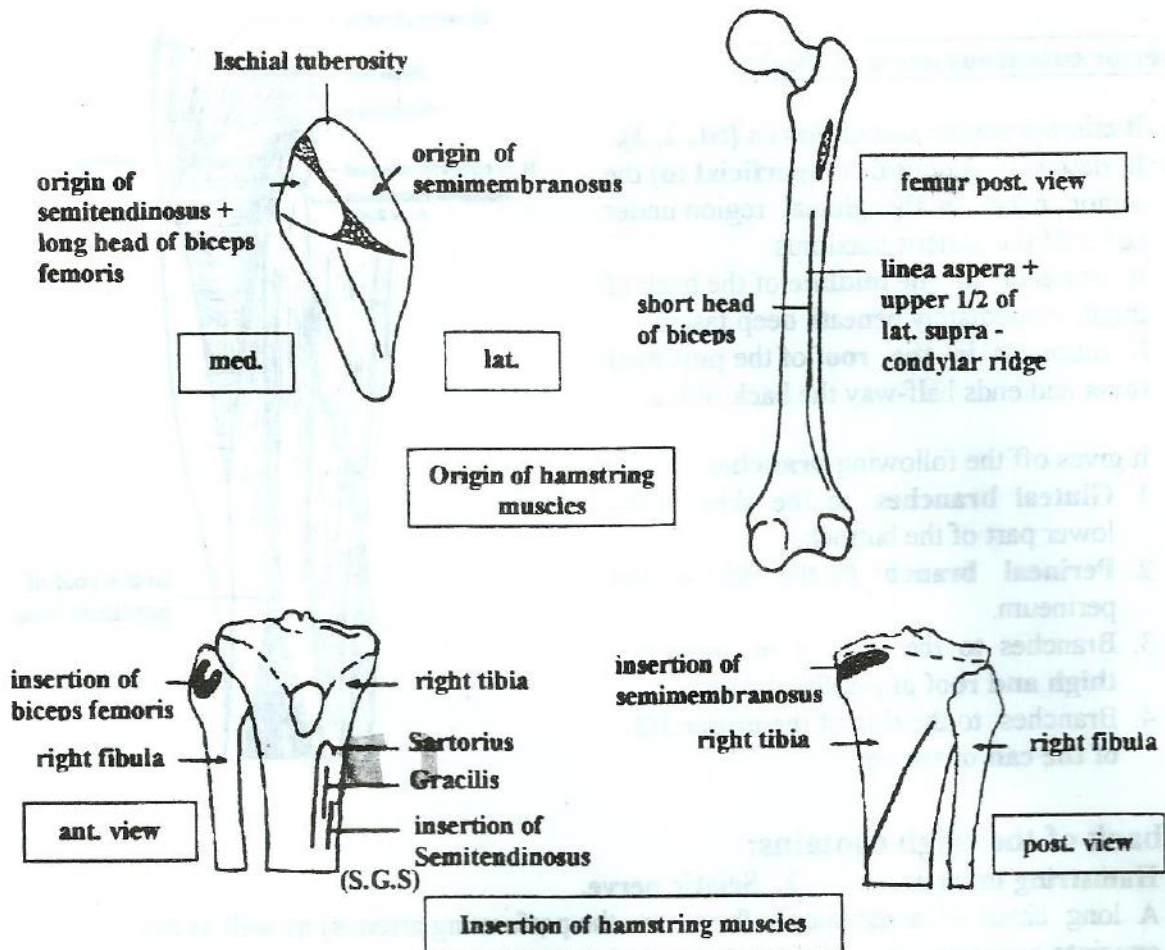
They are the main **flexors** of the knee but they are also **extensors** of the hip joint.

They are 3 muscles: **biceps femoris**, **semitendinosus** and **semimembranosus**.

Characteristics of hamstring muscles:

- All arise from ischial tuberosity.
- All inserted into the upper end of tibia and fibula.
- All supplied by sciatic nerve.
- The muscles inserted into tibia (semimembranosus & semitendinosus) rotate the leg medially.
- The muscle inserted into fibula rotates the leg laterally.



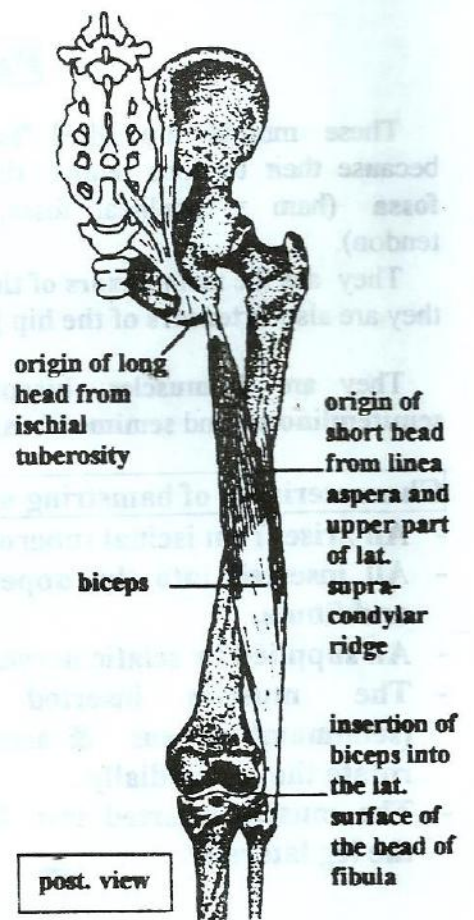


Biceps femoris

- **Origin:** by 2 heads:
 1. **Long head:** arises in common with the semitendinosus from the medial area of the upper part of the ischial tuberosity.
 2. **Short head:** from the linea aspera and upper 1/2 of the lateral supracondylar line (ridge).
- **Insertion:** into the lateral surface of the head of the fibula.
- **Nerve supply:** by 2 branches from the sciatic nerve, one for each head as follows:
 1. **Long head:** from the medial (tibial) part of the nerve.
 2. **Short head:** from the lateral (common peroneal) part of the nerve.
- **Action:**
 1. The whole muscle **flexes** the knee and **rotates** the leg laterally.
 2. The long head is a **weak extensor** of the hip joint.

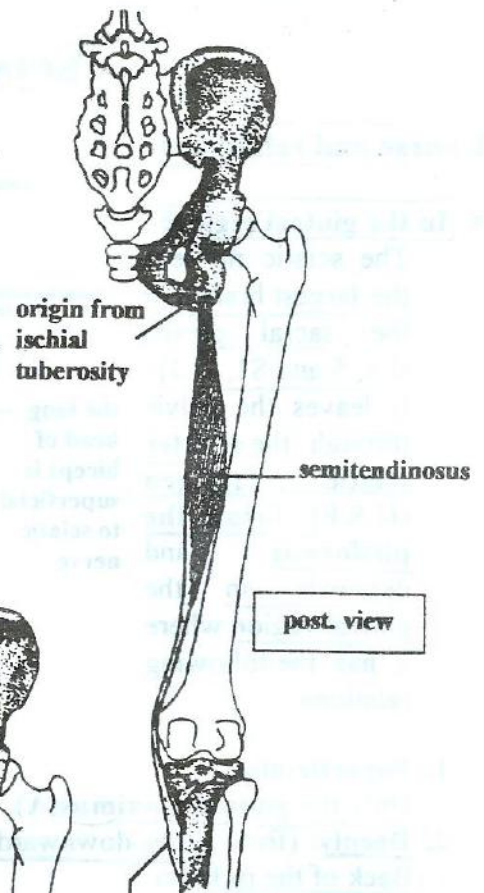
Important relations:

1. The long head overlies the sciatic nerve.
2. The **tendon** of insertion is **related** medially to the common peroneal nerve.

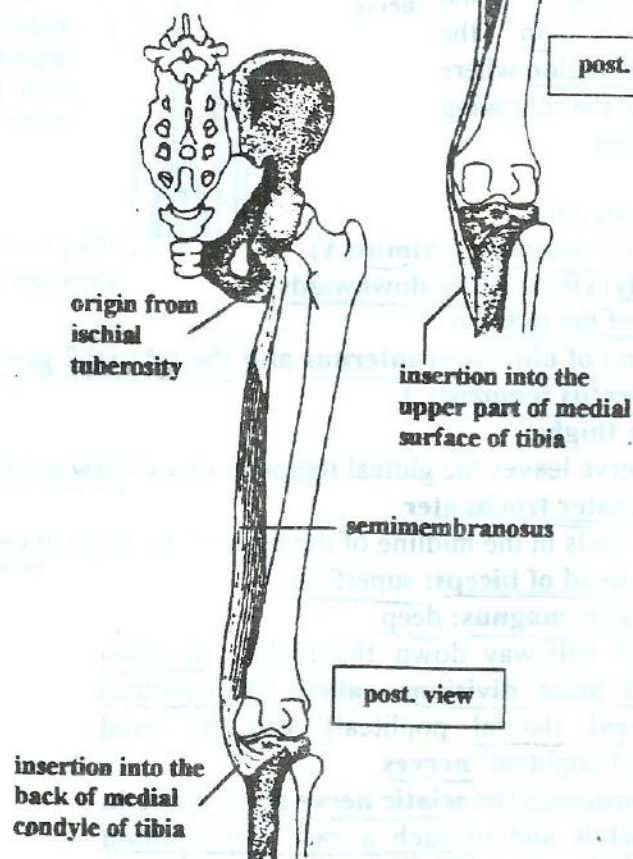


Semitendinosus

- **Origin:** it arises in common tendon with the long head of biceps from the medial area of the upper part of the ischial tuberosity.
- **Insertion:** the muscle lies on the medial side of the back of the thigh superficial to the semimembranosus. It is inserted into the upper part of the medial surface of the tibia.
- **Nerve supply:** sciatic nerve.
- **Action:**
 1. It is a flexor of the knee and medial rotator of the leg.
 2. It is a weak extensor of the hip joint.

**Semimembranosus**

- **Origin:** from the lateral area of the upper part of the ischial tuberosity. The muscle is slightly folded to form a groove for the semitendinosus (Its upper part is membranous and hence called semimembranosus).
- **Insertion:** Into a groove on the back of the medial condyle of tibia.
- **Nerve supply:** sciatic nerve.
- **Action:**
 1. It is a flexor of the knee and medial rotator of the leg.
 2. It is a weak extensor of the hip joint.

**Summary for the muscles of the posterior compartment (Hamstring muscles)**

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Biceps femoris	Long head: ischial tuberosity Short head: linea aspera, lateral supracondylar ridge of shaft of femur	Head of fibula	Long head: tibial portion of sciatic nerve Short head: common peroneal portion of sciatic nerve	Flexes and laterally rotates leg at knee joint; long head also extends thigh at hip joint
Semitendinosus	Ischial tuberosity	Upper part of medial surface of shaft of tibia	Tibial portion of sciatic nerve	Flexes and medially rotates leg at knee joint; extends thigh at hip joint
Semimembranosus	Ischial tuberosity	Medial condyle of tibia	Tibial portion of sciatic nerve	Flexes and medially rotates leg at knee joint; extends thigh at hip joint
Adductor magnus (hamstring portion)	Ischial tuberosity	Adductor tubercle of femur	Tibial portion of sciatic nerve	Extends thigh at hip joint

SCIATIC NERVE

Course and relations:

• In the gluteal region:

- The sciatic nerve is the largest branch of the sacral plexus (L4, 5 and S1, 2, 3).
- It leaves the pelvis through the greater sciatic foramen (G.S.F) below the piriformis and descends in the gluteal region where it has the following relations:

1. Superficially:

Only the gluteus maximus(A).

2. Deeply: (from above downwards).

- Back of the ischium.
- Tendon of obturator internus and the related 2 gemelli(B).
- Quadratus femoris(C).

• In the thigh:

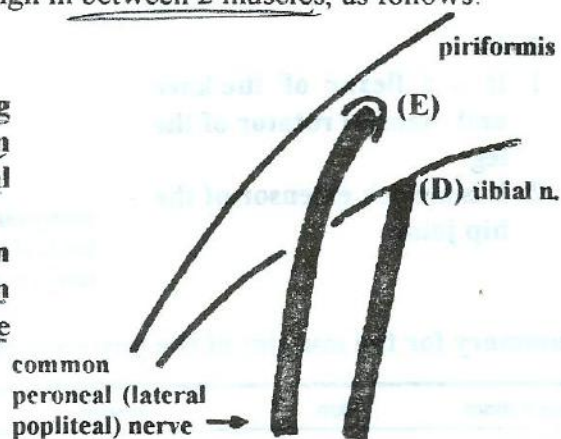
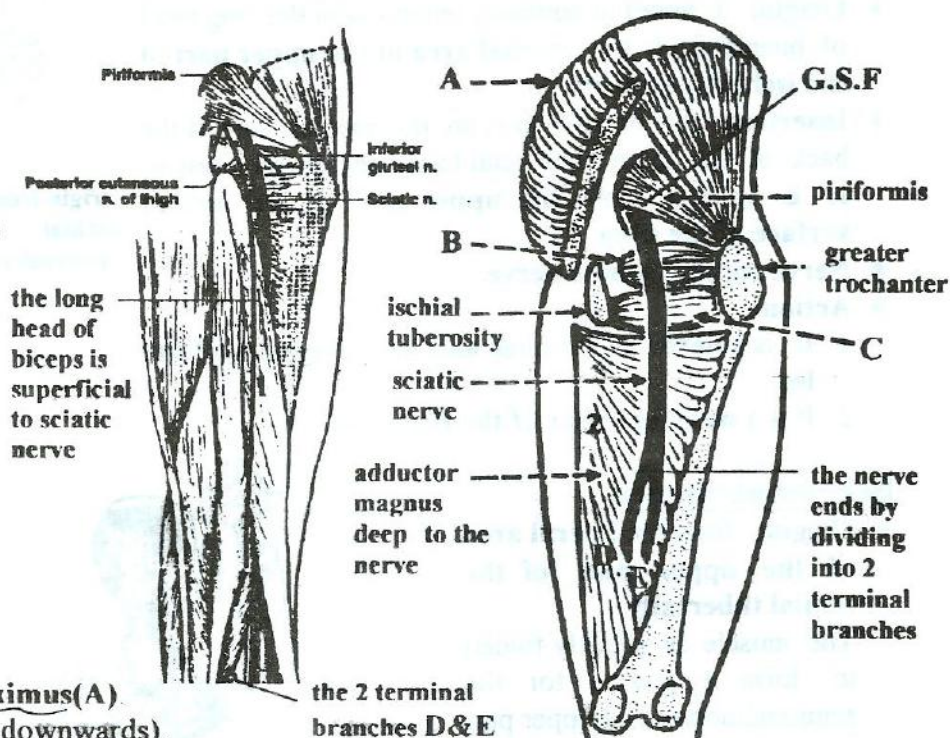
- The nerve leaves the gluteal region midway between the ischial tuberosity and the greater trochanter.
- It descends in the midline of the back of the thigh in between 2 muscles, as follows:
 - (1) Long head of biceps: superficial
 - (2) Adductor magnus: deep.
- It ends half-way down the thigh by dividing into 2 main divisions called: The common peroneal (lateral popliteal) and the tibial (medial popliteal) nerves.

N.B.: Sometimes the sciatic nerve splits while in the pelvis and in such a case the common peroneal part(E) pierces part piriformis while the tibial part(D) passes below the muscle.

Branches:

1. Terminal divisions: the tibial nerve(D) (medially) and the common peroneal(E) nerve (laterally) (medial & lateral popliteal nerves).
2. Muscular branches: to
 - a. Biceps femoris: a branch to each head.
 - b. Semitendinosus.
 - c. Semimembranosus.
 - d. Ischial part of adductor magnus.

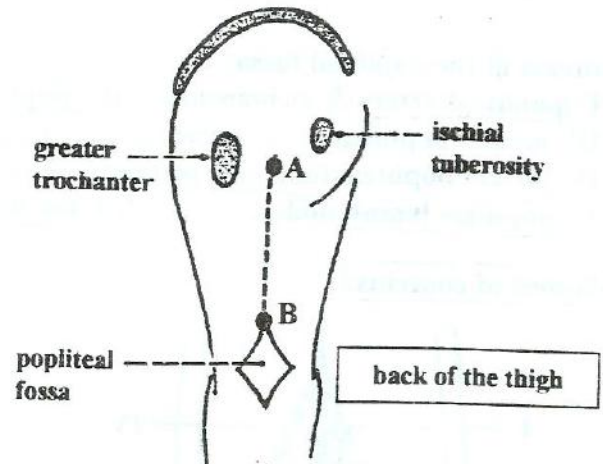
N. B.: All muscular branches arise from its medial (tibial) part except that for the short head of biceps which arises from its lateral (common peroneal) part.



Surface anatomy:

The sciatic nerve is represented by a line on the midline of the back of the thigh drawn between the following 2 points:

1. Upper point(A): midway between the ischial tuberosity and greater trochanter.
2. Lower point(B): at the back of thigh, in the middle line at apex of popliteal fossa.

**Effect of injury:**

A lesion to the sciatic nerve in the gluteal region results in:

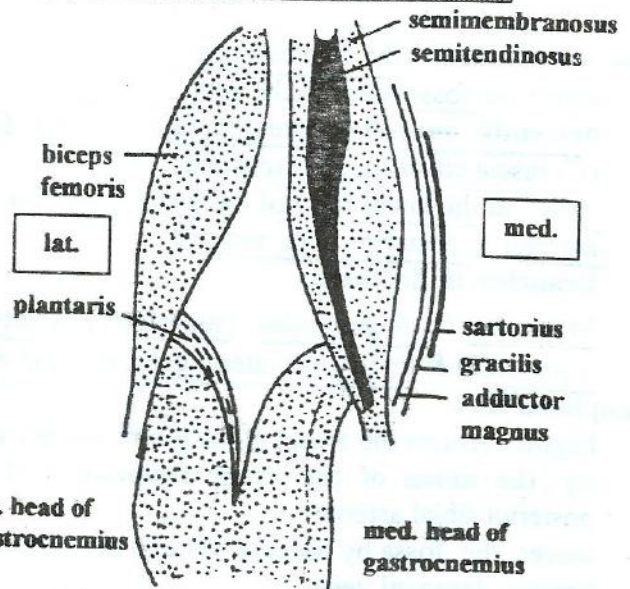
1. Paralysis of the 3 hamstrings and ischial part of adductor magnus.
2. Paralysis of all muscles of the leg (all 3 compartments) and of the foot (dorsum and sole).
3. Sensory loss of the skin of the leg and foot except the areas supplied by the saphenous nerve (on the medial side) and posterior cutaneous nerve of thigh (on the back of the calf).

POPLITEAL FOSSA**Boundaries:**

It is a diamond-shaped space.

It has four boundaries.

1. Upper lateral boundary: biceps femoris only.
2. Upper medial boundary: semitendinosus, semimembranosus supplemented by the sartorius, gracilis and tendon of adductor magnus.
3. Lower lateral boundary: lateral head of gastrocnemius supplemented by the plantaris.
4. Lower medial boundary: medial head of gastrocnemius only.



Boundaries of left popliteal fossa

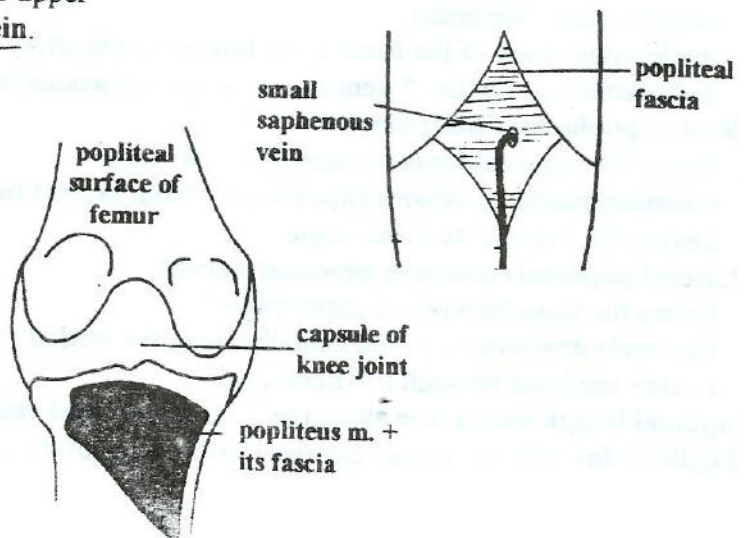
Roof:

- skin.
- superficial fascia containing the upper part of the small saphenous vein.
- deep fascia (popliteal fascia).

Floor:

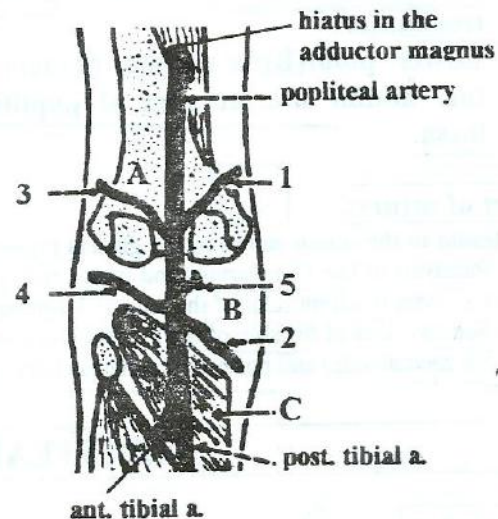
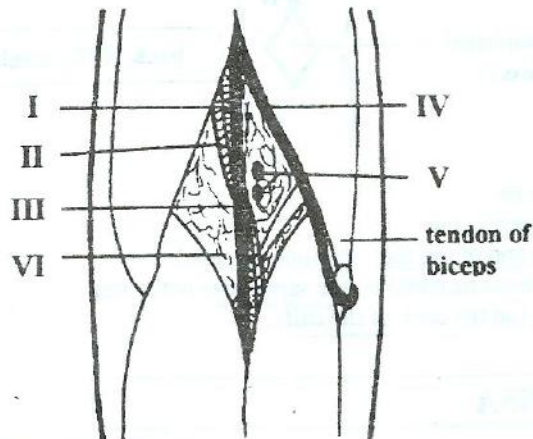
- upper part: popliteal surface of the femur.
- middle part: capsule of knee joint.
- lower part: fascia covering the popliteus muscle.

N.B.: The lower part of the fossa is the distal border of the popliteus.



Contents of the popliteal fossa:

- I. popliteal artery & its branches.
- II. popliteal vein & its tributaries.
- III. medial popliteal (tibial nerve) & its branches.
- IV. lateral popliteal (common peroneal) nerve & its branches.
- V. popliteal lymph nodes.
- VI. variable amount of fat.

Relations of contents:**I. popliteal artery: (the deepest structure):**

- enters the fossa through the adductor hiatus.
- descends on: (A) popliteal surface of femur. (B) Back of capsule of knee joint. (C) fascia covering popliteus muscle.
- ends: at the lower limit of the fossa (lower border of popliteus) by dividing into anterior & posterior tibia; arteries.
- **Branches in the fossa:**

Muscular + 5 genicular (superior(1) & inferior(2) medial genicular arteries, superior(3) & inferior(4) lateral genicular and middle(5) genicular arteries)

II. popliteal vein:

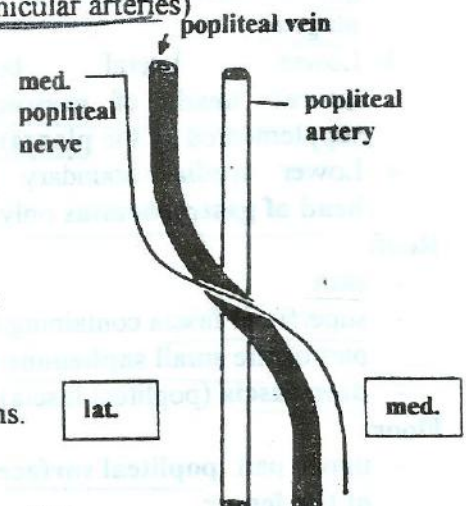
- begins (enters the fossa) at the lower border of popliteus by the union of the **venae comitantes** of anterior & posterior tibial arteries.
- leaves the fossa by passing through the adductor hiatus to become **femoral vein**.
- In the lower part of the fossa it lies **medial** to the artery.
- In the middle part of the fossa it lies **posterior** (superficial) to the artery.
- In the upper part of the fossa it lies **lateral** to the artery.
- **Tributaries:** muscular, 5 genicular & small saphenous veins.

III. Medial popliteal (tibial) nerve:

- Enters the popliteal fossa through its upper angle.
- **Crossing popliteal vessels superficially from lateral to medial.**
- Leaves the fossa at its lower angle.

IV. Lateral popliteal (common peroneal) nerve:

- Enters the fossa through its upper angle.
- Descends downwards & laterally along the medial side of biceps tendon.
- Leaves the fossa through its lateral angle.

V. Popliteal lymph nodes: Lie along the sides of popliteal vessels.**VI. Popliteal fat:** fills the spaces between the contents of the popliteal fossa.

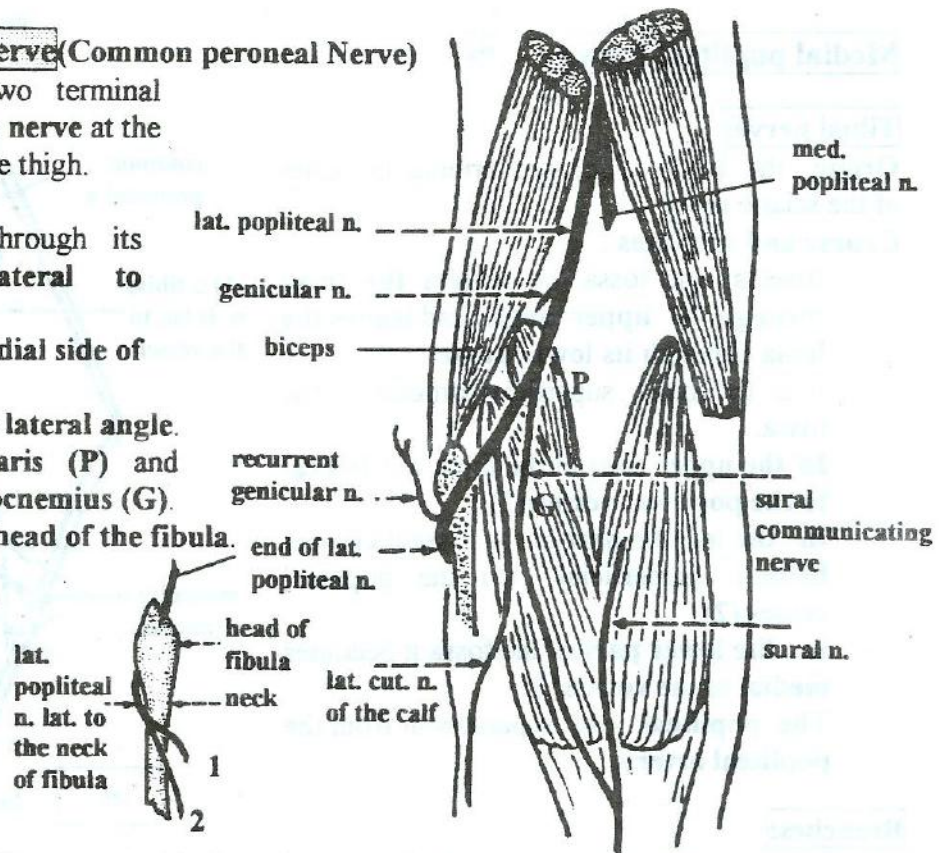


Lateral Popliteal Nerve (Common peroneal Nerve)

Origin: One of the two terminal branches of the sciatic nerve at the middle of the back of the thigh.

Course and relations:

- enters the fossa through its upper angle lateral to popliteal artery.
- runs close to the medial side of the biceps femoris.
- leaves the fossa at its lateral angle.
- crosses the plantaris (P) and lateral head of gastrocnemius (G).
- descends behind the head of the fibula.
- curves forwards on the lateral side of the neck of the fibula where it terminates by dividing into:
 - anterior tibial(1) nerve and
 - musculo-cutaneous(2) nerve, inside the substance of peroneus longus muscle.



Branches:

a. Cutaneous:

1. **Lateral cutaneous nerve of calf:** supplies the skin of the posterior, lateral, and anterior surfaces of the upper part of the leg.
2. **Sural communicating:** which joins the sural nerve (a branch from tibial nerve).

b. Muscular: no muscular branches.

c. Articular: to the knee joint:

1. **superior lateral genicular nerve.**
2. **inferior lateral genicular nerve.**
3. **recurrent genicular nerve.**

d. Terminal branches:

1. **anterior tibial nerve.**
2. **musculo-cutaneous nerve.**

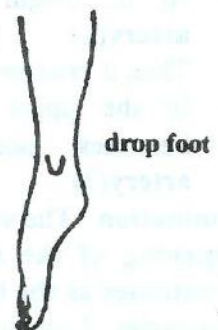
Effect of injury:



Injury to the common peroneal nerve affects mainly its 2 terminal divisions which are the superficial (musculo coetaneous) and deep peroneal (anterior tibial) nerves.

This leads to both motor and sensory effects, as follows:

1. **Paralysis of all extensors:** of the foot situated in the anterior compartment of the leg (supplied by deep peroneal) resulting in "drop foot".
2. **Paralysis of peroneus longus and brevis** (supplied by superficial peroneal), resulting in loss of eversion of the foot.
3. **Loss of sensation in the following areas:**
 - a. **Anterolateral surface of the upper part of the leg:** supplied by lateral cutaneous nerve of calf.
 - b. **Front of the lower part of the leg:** supplied by superficial peroneal nerve.
 - c. **Dorsum of the foot and toes:** supplied by the superficial peroneal nerve.



Medial popliteal Nerve

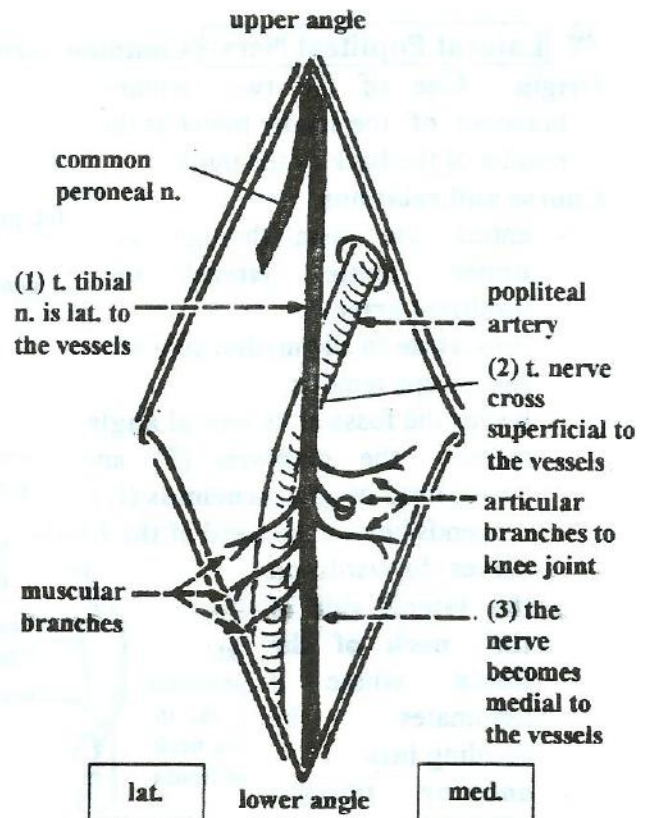


Tibial nerve:

Origin: the larger of the two terminal branches of the sciatic nerve.

Course and relations:

- Bisects the fossa. i.e. enters the fossa through its upper angle and leaves the fossa through its lower angle.
- It is the most superficial structure in the fossa.
- In the upper part of the fossa it is lateral to the popliteal vessels(1).
- In the middle part of the fossa it crosses behind (superficial to) the popliteal vessels(2).
- In the lower part of the fossa it becomes medial to the vessels(3).
- The popliteal vein separates it from the popliteal artery.



Branches:

- a. **Cutaneous: sural nerve** which supplies the skin of the posterior and lateral parts of the leg and lateral part of the foot.
- b. **Muscular: 5 branches to:**
 1. medial head of gastrocnemius. 2. lateral head of gastrocnemius. 3. plantaris.
 4. popliteus. 5. soleus.
- c. **Articular: to the knee joint**
 1. superior medial genicular nerve. 2. middle genicular nerve.
 3. inferior medial genicular nerve.

Termination: At the distal border of popliteus it continues into the posterior compartment of the leg as the posterior tibial nerve (tibial nerve).

Popliteal vein

Origin:

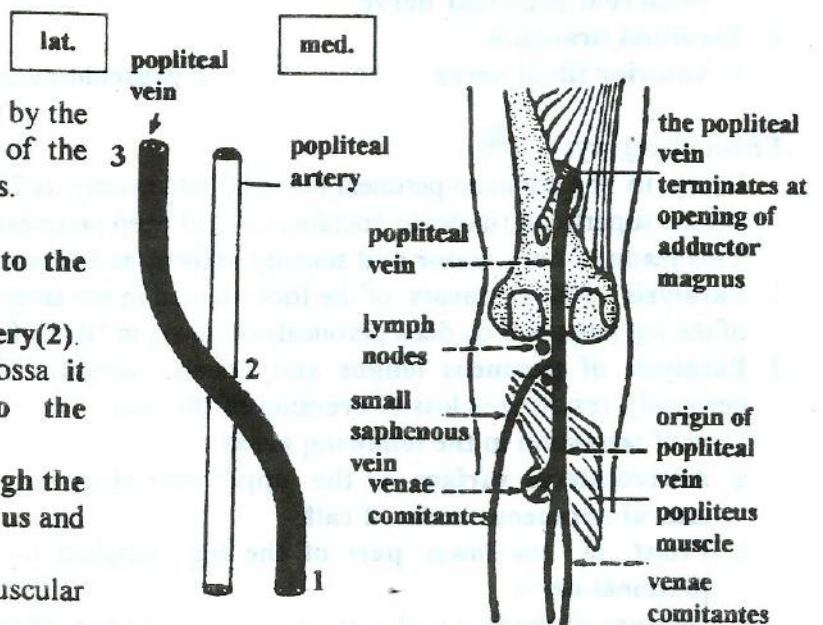
At the distal border of popliteus by the union of the venae comitantes of the anterior and posterior tibial arteries.

Course:

- At its origin it is medial to the artery(1).
- Then it crosses behind the artery(2).
- In the upper part of the fossa it becomes postero-lateral to the artery(3).

Termination: The vein passes through the opening of the adductor magnus and continues as the femoral vein.

Tributaries: 1. genicular veins. 2. muscular veins. 3. small saphenous vein.



Popliteal Artery

Origin: continuation of femoral artery at the Opening in the adductor magnus.

Termination: At the distal border of popliteus it terminates by dividing into anterior and posterior tibial arteries.

Course and relations:

Deep relations: it runs on the floor of the fossa.

- In the upper part of the fossa the artery lies on the **popliteal surface of the femur**, separated by a small amount of fat.
- In the middle of the fossa it lies on the **capsule of knee joint**.
- In the lower part of the fossa it lies on the **fascia covering the popliteus muscle**.

Superficial relations: popliteal vein and medial popliteal nerve cross superficial to the artery in the middle of the fossa.

Relation to popliteal vein:

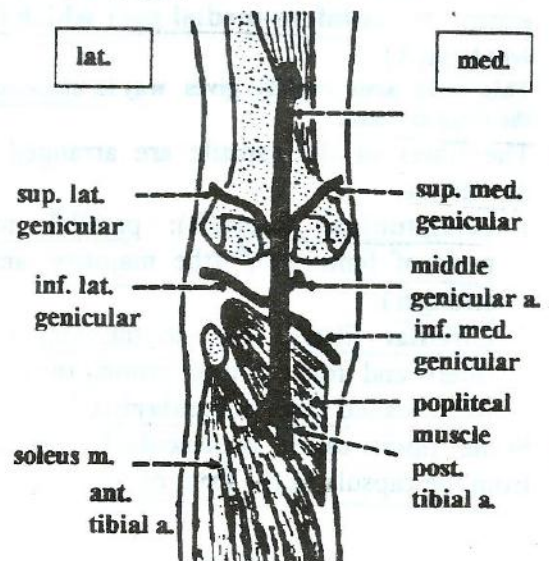
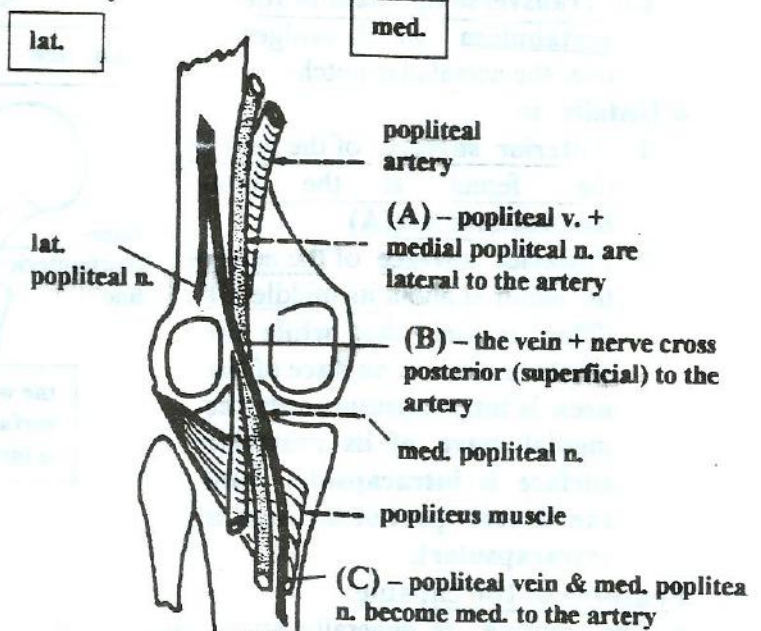
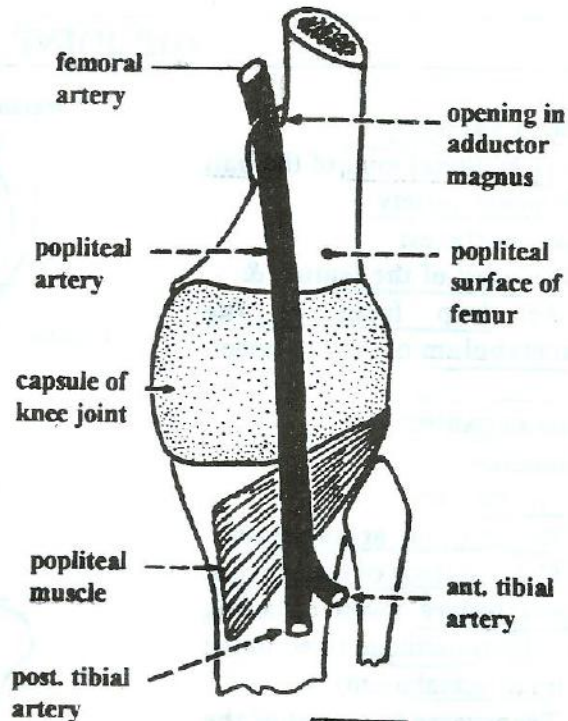
- In the upper part of the fossa, the vein is **postero-lateral(A)** to the artery.
- In the middle of the fossa, the vein crosses **posterior(B)** to (superficial to) the artery and separates it from the medial popliteal nerve.
- In the lower part of the fossa, the vein becomes **medial(C)** to the artery.

Relation to the medial popliteal nerve:

- In the upper part(A) of fossa the nerve is lateral to the artery.
- In the middle(B) of the fossa it becomes posterior to the artery.
- In the lower part(C) of the fossa it becomes medial to the artery.

Branches:

- Muscular:** the muscles of the fossa.
- Cutaneous:** to the skin.
- Articular:** gives five branches which accompany the genicular nerves. 1. superior medial genicular, 2. superior lateral genicular, 3. middle genicular, 4. inferior medial genicular & 5. inferior lateral genicular arteries.



HIP JOINT

Type and variety:

- It is a synovial joint of the ball and socket variety.

Articular surfaces:

- (1) The head of the femur, &
- (2) The deep fossa of the acetabulum of the hip bone.

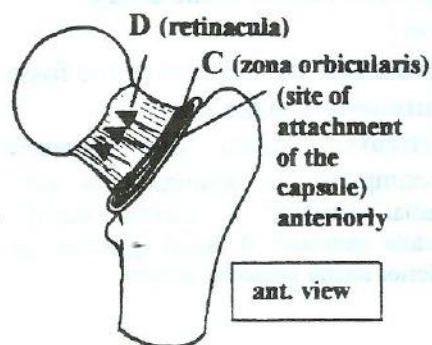
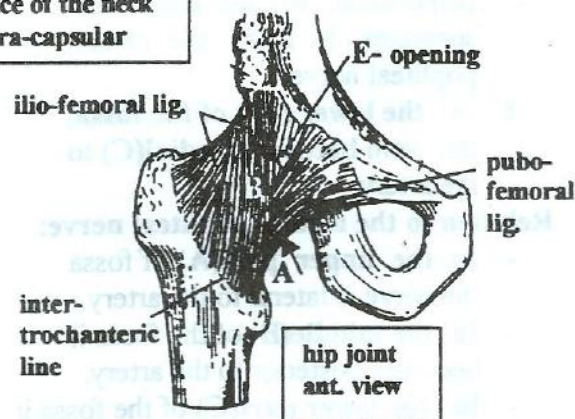
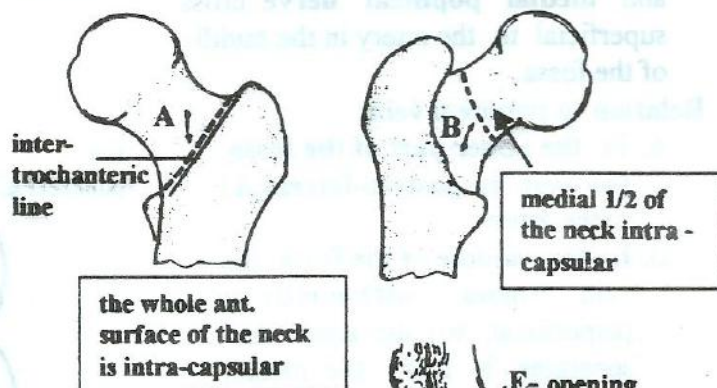
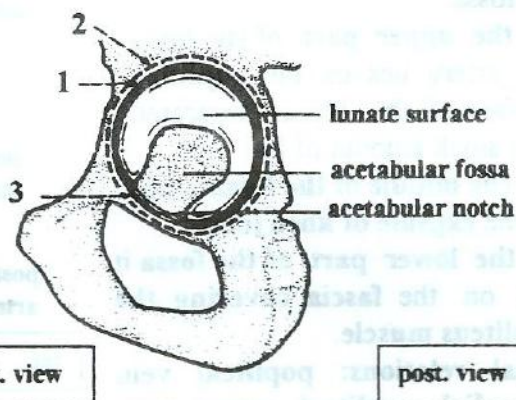
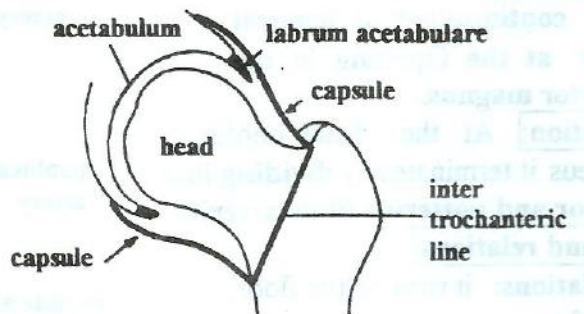
Fibrous capsule:

Attachments:

- Proximally:** to:
 - (1) Margin of the acetabulum.
 - (2) Outer surface of the labrum acetabulare (which is a ring of fibro-cartilage fixed to the rim of acetabulum).
 - (3) Transverse ligament of the acetabulum which bridges over the acetabular notch.
- Distally:** to:
 1. Anterior surface of the neck of the femur at the inter-trochanteric line (A).
 2. Posterior surface of the neck of the femur at about its middle (B). (This means that while the whole anterior surface of the neck is intracapsular, only the medial part of its posterior surface is intracapsular, and the lateral part of the neck is extracapsular).

Features of the capsule:

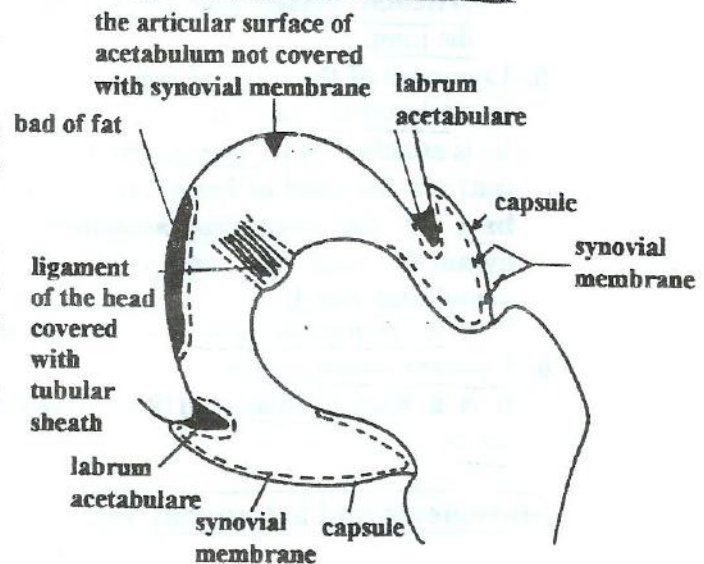
- The capsule is generally strong and dense except at its infero-medial part which is the weakest (A).
This weak area rapidly gives way in dislocation of the head of femur.
- The fibers of the capsule are arranged in 2 directions
 1. Longitudinal fibers (B): parallel to the neck of femur (the majority and are stronger).
 2. Circular fibers: deep to the longitudinal fibers and form a ring around the neck of femur called zona orbicularis (C).
- Some fibers called retinacula (D) are reflected from the capsule to the front of the neck of femur.



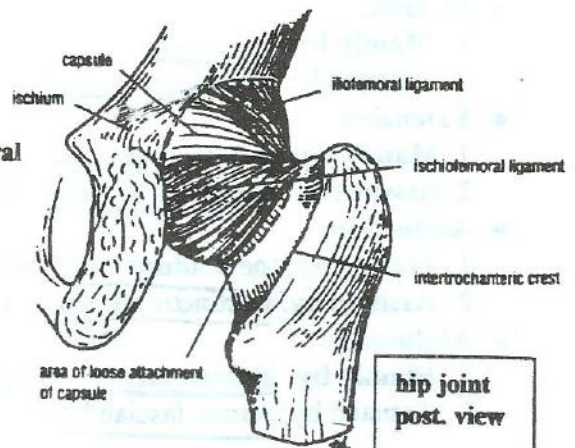
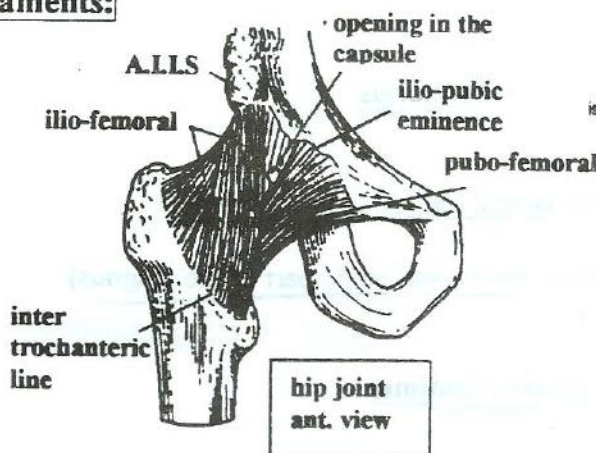
- These retinacula carry blood vessels to the head and neck of the femur.
- They are covered with synovial membrane.
- The capsule shows an opening(E) at the interval between the ilio-femoral and pubo-femoral ligaments.
- At this opening the synovial membrane of the joint communicates with the bursa placed deep to the iliopsoas muscle.

Synovial membrane:

1. It lines the fibrous capsule from which it is reflected on to the neck of femur covering it as far as the articular margin.
2. It covers the floor of the acetabulum except the articular surface which is in the form of an incomplete ring (lunate surface).
3. It gives a tubular sheath for the ligament of the head of femur.
4. It covers both surfaces of the labrum acetabulare.



Ligaments:



There are 3 main ligaments (ilio-femoral, pubo-femoral and ischio-femoral) and 3 others (transverse acetabular, ligament of the head and labrum acetabulare).

1. Ilio-femoral ligament:

- It has an inverted Y-shape with its apex attached to the anterior inferior iliac spine (A.I.L.S.) (deep to the straight head of rectus femoris). It has medial and lateral limbs which are attached to the intertrochanteric line on the front of the neck.
- The ligament is the strongest of all ligaments of the body and its function is to resist hyperextension of the joint.

2. Pubo-femoral ligament:

It extends from the ilio-pubic eminence and adjoining part of the superior ramus of the pubis to the capsule and lower part of the intertrochanteric line.

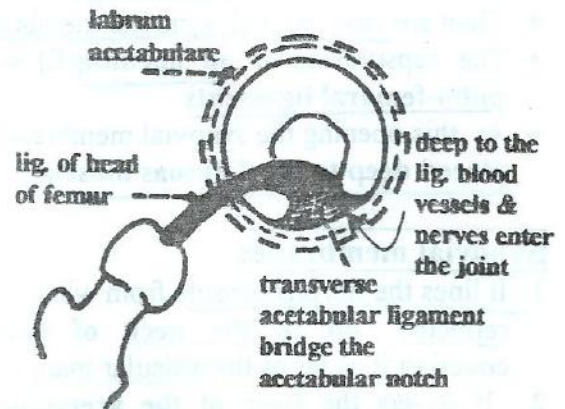
3. Ischio-femoral ligament:

It is the weakest, and extends in a spiral manner from the ischium just below the acetabulum to the back of the capsule.

Note: - Ilio-femoral: from ilium to femur.
 - Pubo-femoral: from pubis to femur.
 - Ischio-femoral: from ischium to femur.

4. Transverse acetabular ligament:

- It is attached to the edges of the acetabular notch on the lower margin of the acetabulum.
- Deep to this ligament, the articular vessels and nerves enter the joint.

**5. Ligament of the head of femur:**

It is triangular and flat.

It is attached by its apex to the fovea (pit) on the head of femur and by its base to the transverse acetabular ligament and the edges of the acetabular notch.

It has no role in stabilizing the joint, but it becomes tense when the thigh is flexed and adducted.

6. Labrum acetabulare:

It is a ring of fibro-cartilage fixed to the rim of the acetabulum to deepen its cavity.

Movements and acting muscles:**• Flexion:**

1. Mainly by: iliopsoas.
2. Assisted by: pectineus, rectus femoris and sartorius.

• Extension:

1. Mainly by: gluteus maximus.
2. Assisted by: hamstring muscles and ischial part of adductor magnus.

• Adduction:

1. Mainly by: the 3 adductors (longus, brevis and pubic part of the magnus).
2. Assisted by: pectineus and gracilis.

• Abduction:

1. Mainly by: gluteus medius and gluteus minimus.
2. Assisted by: tensor fasciae latae.

• Lateral rotation:

It is stronger than medial rotation.

The muscles responsible for lateral rotation are 6 muscles.

- | | |
|------------------------|-----------------------|
| 1. Obturator externus. | 2. Obturator internus |
| 3. Quadratus femoris. | 4. Piriformis. |
| 5. Superior gemellus. | 6. Inferior gemellus. |

• Medial rotation: by

1. Tensor fasciae latae.
2. Anterior fibers of the gluteus medius and gluteus minimus.

Nerve supply:

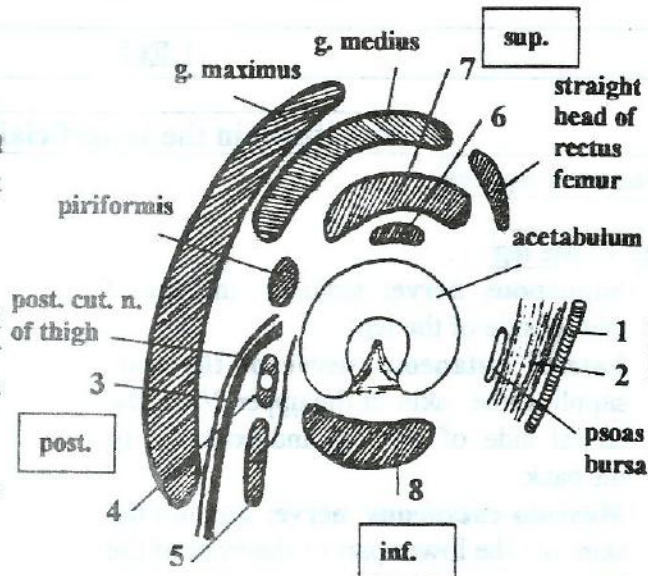
Femoral, obturator & sciatic nerves + nerve to quadratus femoris.

Blood supply:

It receives branches from gluteal, circumflex and obturator arteries.

Main relations:

- **Anteriorly:**
These are the femoral nerve and femoral vessels(1), but are separated from the joint by the iliopsoas muscle(2).
- **Posteriorly:**
It is the sciatic nerve(3), but is separated from the joint by the tendon of obturator internus(4) and by the quadratus femoris muscle(5).
- **Superiorly:** reflected head of rectus femoris(6) & gluteus minimus(7).
- **Inferiorly** obturator externus(8).

**Remember that:**

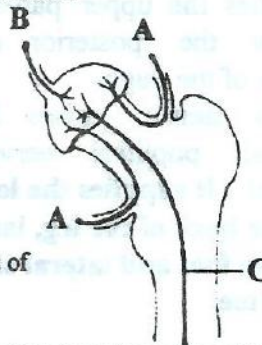
The hip joint is more stable than the shoulder joint due to the following factors:

1. The acetabulum forms a deep socket (as compared with the shallow glenoid cavity).
2. The head of femur is closely fitted to the acetabulum and is held in place by the labrum acetabulare (as compared with the head of the humerus which is not closely fitted).
3. The ligaments are very strong (Note that the ilio-femoral ligament is the strongest of all ligaments of the body).
4. The surrounding muscles are very powerful.

Remember that about the blood supply of the head of femur:

The head of femur is supplied by:

- (A) Along the retinacula: by
 1. Ascending branch of the lateral circumflex femoral artery.
 2. Ascending branch of the medial circumflex femoral artery.
- (B) Along the ligament of the head of femur: by
 1. Acetabular branch of the obturator artery.
 2. Acetabular branch of the medial circumflex femoral artery.
- (C) Nutrient branch from the 2nd or 3rd perforating artery (branches of profunda femoris artery).
This branch ascend from the soft of the neck and them to the head.

**Remember that about the hip joint:**

It is synovial joint, ball and socket variety.

Possible movements:

Flexion: by iliopsoas - **Extension:** by gluteus maximus.

Adduction: by 3 adductors (longus, brevis & magnus).

Abduction & medial rotation: by gluteus medius, minimus & tensor fascia latae.

Lateral rotation: by the 6 lateral rotator muscles (piriformis, sup. & inf. gemelli, obturator internus & externus & quadratus femoris).

- All the anterior surface of the neck is intracapsular.
- Only the medial 1/2 of the posterior surface is intracapsular and the lateral 1/2 is extracapsular.

The important ligaments are: ilio-femoral, pubo-femoral & ischio-femoral.

The labrum acetabulare deepen the acetabulum and give more stability to the joint. The head of the femur receives part of its blood supply (from obturator artery) through the ligament of the head of femur.



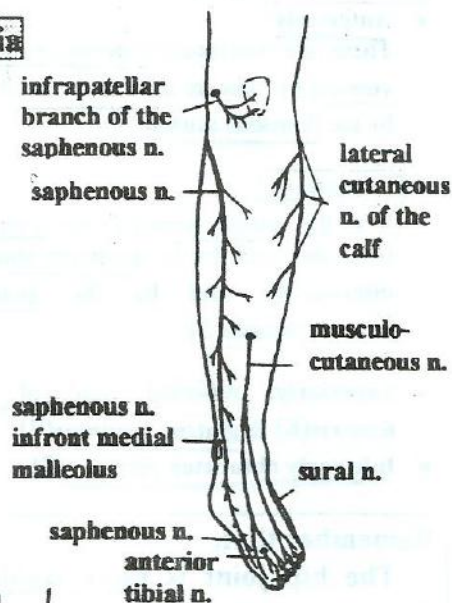
LEG

Structures in the superficial fascia

Cutaneous nerves

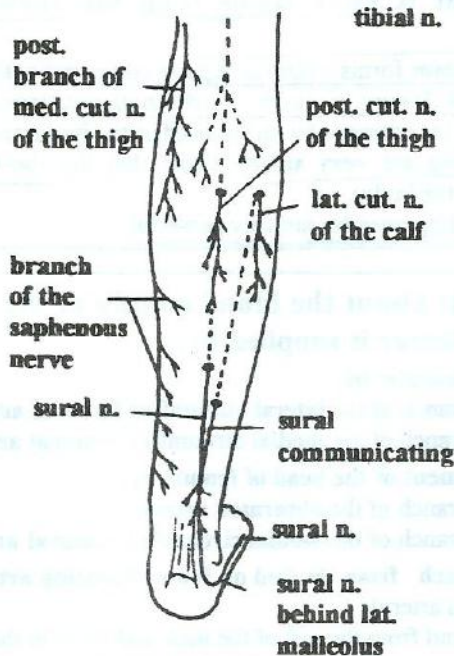
Front of the leg

1. **Saphenous nerve:** supplies the skin of medial side of the leg.
2. **Lateral cutaneous nerve of the calf:** supplies the skin of the upper 2/3 of the lateral side of the leg and extending to the back.
3. **Musculo-cutaneous nerve:** supplies the skin of the lower part of the front of the leg.



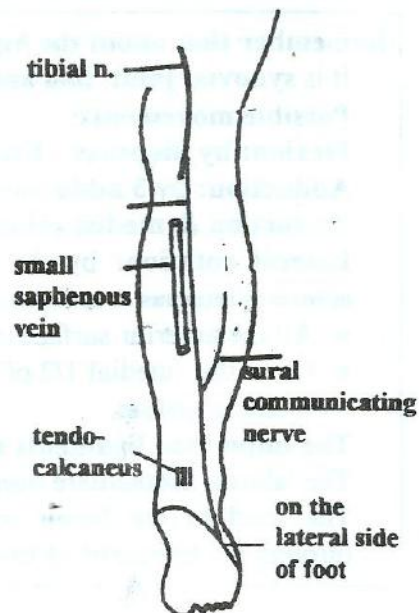
Back of the leg

1. **Medial cutaneous nerve of the thigh:** Its posterior branch supplies the upper and medial part of the back of the leg.
2. **Posterior cutaneous nerve of the thigh:** supplies the upper part of the calf (back of the leg).
3. **Sural communicating nerve:** supplies the upper part of the calf below the posterior cutaneous nerve of the thigh.
4. **Sural nerve:** arises from the medial popliteal nerve (tibial nerve). It supplies the lower part of the back of the leg, lateral side of the foot and lateral side of the little toe.



More details about sural nerve:

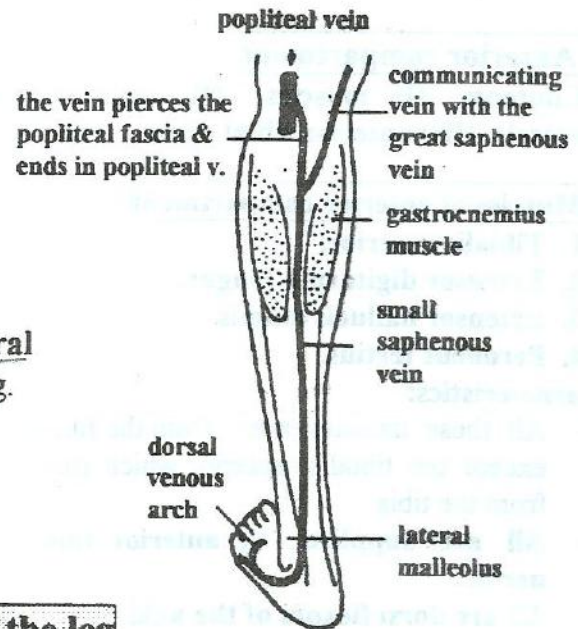
- It is the only cutaneous branch of the tibial nerve (medial popliteal nerve) in the popliteal fossa.
- The sural nerve arises in the middle of the fossa and descends between the 2 heads of the gastrocnemius alongside the small saphenous vein.
- About the middle of the calf it is joined by the sural communicating nerve (a branch from the common peroneal), and thereafter continues its course along the lateral margin of the tendo-calcaneus.
- It then runs along the lateral side of the foot as far forwards as the end of the little toe.
- It supplies the skin of lower parts of the posterior and lateral surfaces of the leg as well as the skin on the lateral side of the foot.



Superficial veins

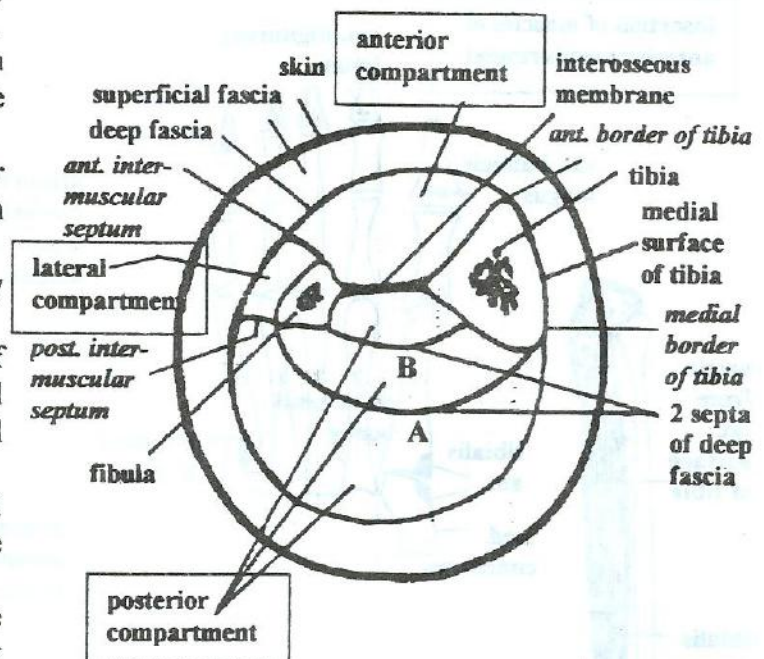
→ Small saphenous vein

- Arises from the lateral end of the dorsal venous arch.
- Runs back wards on the lateral border of the foot.
- Curves below and behind the lateral malleolus and ascends in the back of the leg.
- Pierces the popliteal fascia and ends in the popliteal vein
- Forms a communication with the great saphenous vein in the thigh.



Compartments of the leg

- The leg is divided into **anterior, lateral and posterior compartments**.
- The **anterior intermuscular septum** connects the deep fascia with the anterior border of the fibula.
- The **posterior intermuscular septum** connects the deep fascia with the posterior border of the fibula.
- The deep fascia does not completely encircle the leg.
- It extends from the anterior (shin) of tibia, round the leg, to the medial border of the tibia. So, the medial surface of tibia is subcutaneous.
- A septum (A) separates the superficial muscles from the deep muscles of the posterior components.
- Another septum (B) separates the tibialis posterior from the flexor hallucis longus and flexor digitorum longus.



A. Anterior (extensor) compartment contains the following:

1. Extensor muscles.
2. Anterior tibial vessels.
3. Anterior tibial nerve (deep peroneal nerve).

B. Posterior (flexor) compartment contains the following:

1. Flexor muscles.
2. Posterior tibial vessels.
3. Posterior tibial nerve (tibial nerve).

C. Lateral (peroneal) compartment contains the following:

1. Peroneus longus and brevis.
 2. Superficial peroneal nerve.
- (No vessels are found in the lateral compartment).

A. Anterior compartment

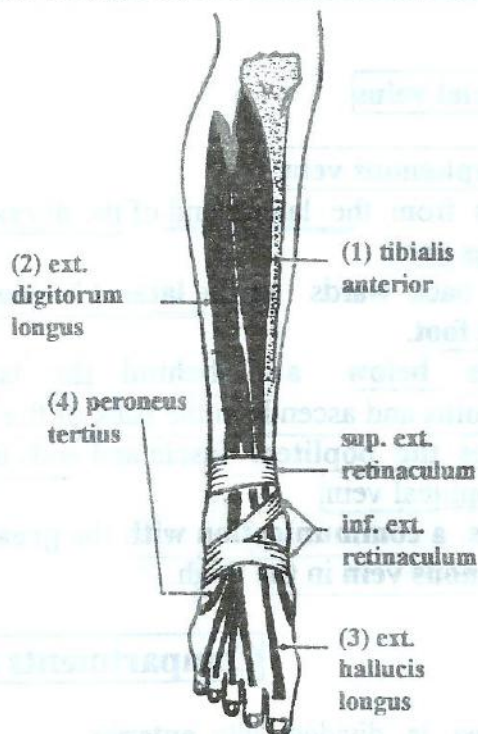
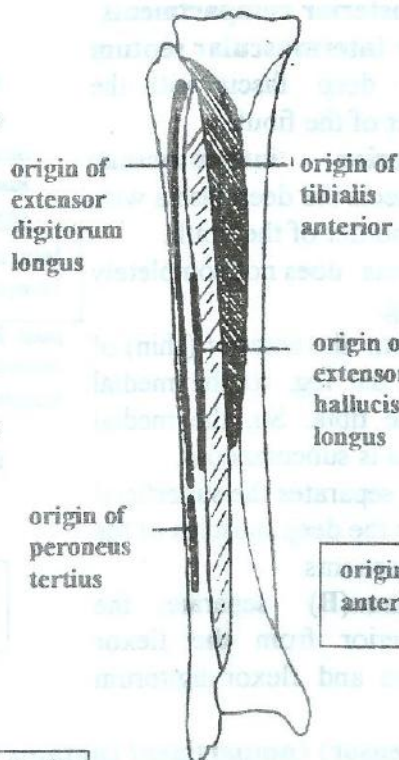
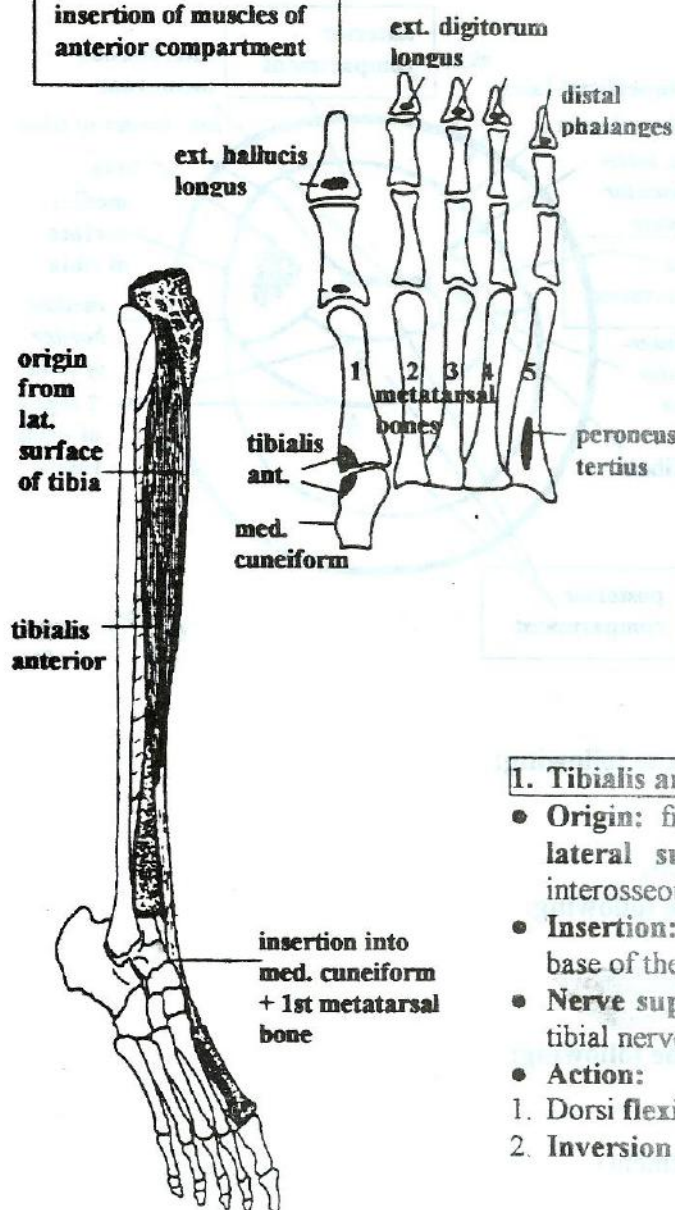
Contents: (I) muscles, (II) anterior tibial vessels, (III) anterior tibial nerve.

I. Muscles of anterior compartment

1. **Tibialis anterior.**
2. **Extensor digitorum longus.**
3. **Extensor hallucis longus.**
4. **Peroneus tertius.**

Characteristics:

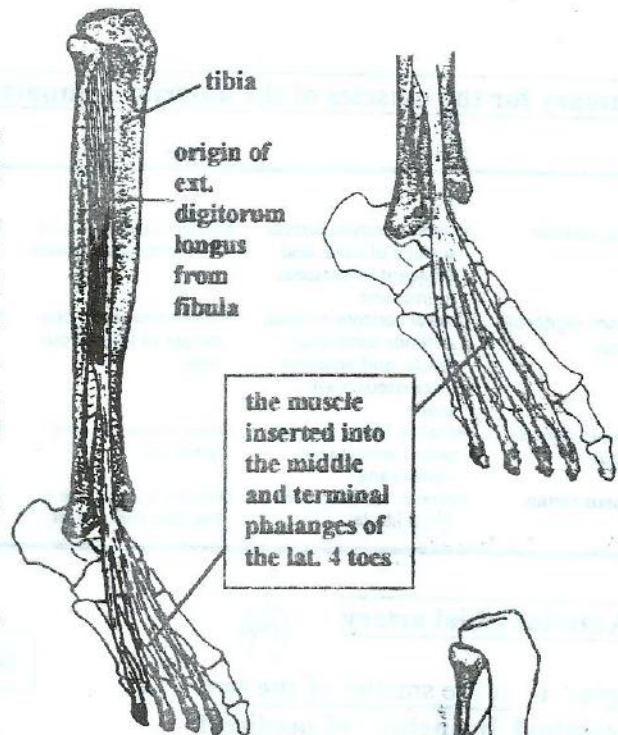
- All these muscles arise from the fibula except the tibialis anterior which arises from the tibia.
- All are supplied by anterior tibial nerve.
- All are dorsi flexors of the ankle.

**insertion of muscles of anterior compartment****origin of muscles of anterior compartment****1. Tibialis anterior**

- **Origin:** from the upper 1/2 or 2/3 of the lateral surface of the tibia and adjacent interosseous membrane.
- **Insertion:** into the medial cuneiform and the base of the 1st metatarsal bone.
- **Nerve supply:** deep peroneal nerve (anterior tibial nerve).
- **Action:**
 1. Dorsi flexion of the foot (at the ankle joint).
 2. Inversion of the foot.

Extensor digitorum longus

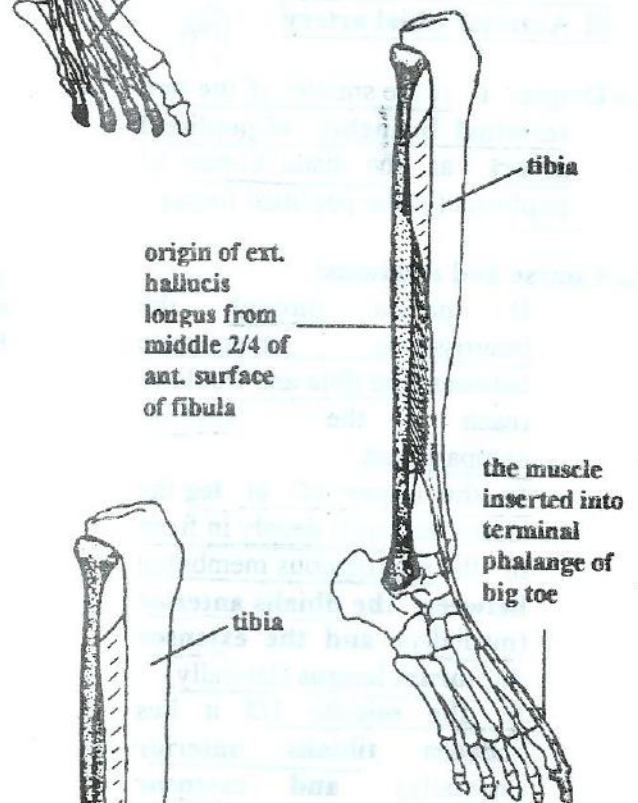
- **Origin:** from the upper 3/4 of the anterior surface of the fibula and adjacent interosseous membrane.
- **Insertion:** the muscle divides into 4 tendons to the lateral 4 toes. Each tendon ends in an extensor expansion which covers the back of the proximal phalanx and gets attached to the base of each of the middle and terminal phalanges.
- **Nerve supply:** deep peroneal nerve (anterior tibial nerve).
- **Action:**
 1. Extension of all joints of the lateral 4 toes.
 2. Dorsi flexion of the ankle joint. (Note that extension of the ankle is called dorsi flexion).

**Extensor hallucis longus**

- **Origin:** from the middle 2/4 of the anterior surface of the fibula and adjacent interosseous membrane.
- **Insertion:** into the dorsum of the base of the terminal phalanx of the big (great) toe.
- **Nerve supply:** deep peroneal nerve (anterior tibial nerve).
- **Action:**
 1. Extension of all joints of the big toe.
 2. Assists in dorsi flexion of the ankle.

origin of ext. hallucis longus from middle 2/4 of ant. surface of fibula

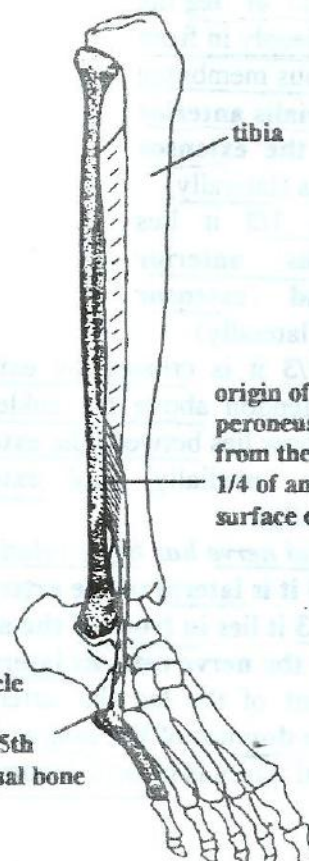
the muscle inserted into terminal phalanx of big toe

**Peroneus Tertius**

- **Origin:** from the lower 1/4 of the anterior surface of the fibula.
- **Insertion:** into the dorsum of the base of the 5th metatarsal.
- **Nerve supply:** deep peroneal nerve (anterior tibial nerve).
- **Action:** helps in eversion and dorsi flexion of the foot.

origin of peroneus tertius from the lower 1/4 of ant. surface of fibula

the muscle inserted into the 5th metatarsal bone



Summary for the muscles of the anterior compartment of the leg

NAME	ORIGIN	INSERTION	ACTION	INNERVATION
Tibialis anterior	Lateral condyle, lateral surface of tibia, and adjacent interosseous membrane	Medial cuneiform and first metatarsal bones	Dorsiflexes the ankle joint and inverts the foot	Deep peroneal nerve
Extensor digitorum longus	Lateral condyle of tibia, anterior surface of fibula, and adjacent interosseous membrane	Middle and distal phalanges of lateral four toes	Extends the toes and dorsiflexes the foot	Deep peroneal nerve
Extensor hallucis longus	Anterior fibula and adjacent interosseous membrane	Distal phalanx of the great toe	Extends the great toe and dorsiflexes the foot	Deep peroneal nerve
Peroneus tertius	Anterior surface of the distal fibula	Dorsum of the base of the fifth metatarsal	Dorsiflexes and everts the foot	Deep peroneal nerve

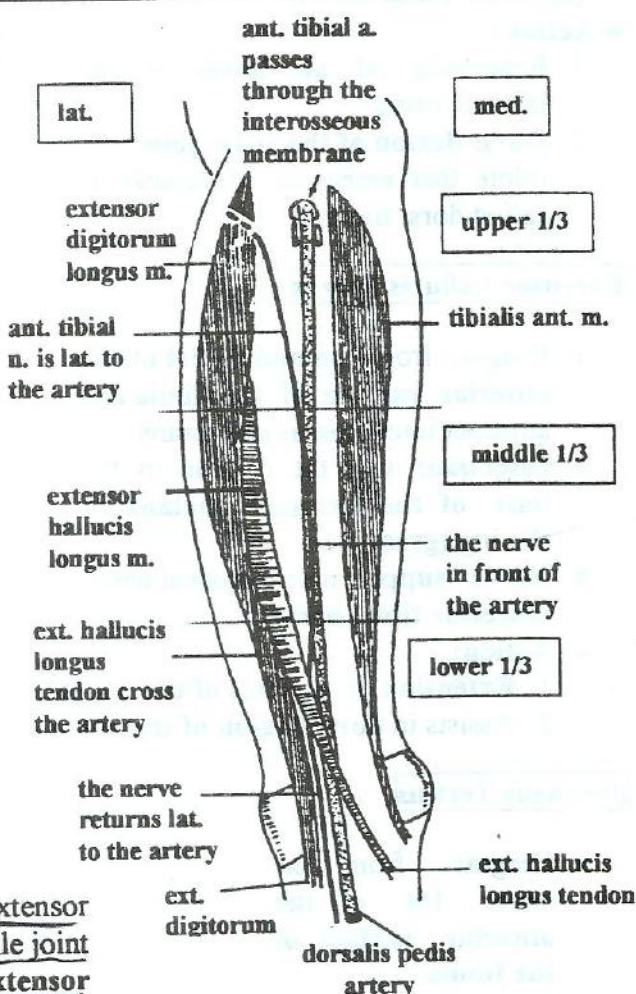
II. Anterior tibial artery



→ **Origin:** It is the smaller of the two terminal branches of popliteal artery, at the distal border of popliteus (in the popliteal fossa).

→ **Course and relations:**

- It passes through the interosseous membrane between the tibia and fibula to reach the anterior compartment.
- In the upper 1/3 of leg the artery descends deeply in front of the interosseous membrane between the tibialis anterior (medially) and the extensor digitorum longus (laterally).
- In the middle 1/3 it lies between tibialis anterior (medially) and extensor hallucis longus (laterally).
- In the lower 1/3 it is crossed by extensor hallucis longus tendon above the ankle joint and the artery now lies between the extensor hallucis longus (medially) and extensor digitorum (laterally).
- The anterior tibial nerve has triple relation to the artery.
- In the upper 1/3 it is lateral to the artery.
- In the middle 1/3 it lies in front of the artery.
- In the lower 1/3 the nerve returns lateral to the artery again.
- At the lower part of the leg the artery crosses in front of the ankle joint and continues on the dorsum of the foot as the dorsalis pedis artery.
- The anterior tibial artery is closely accompanied by two venae comitantes.



Branches:

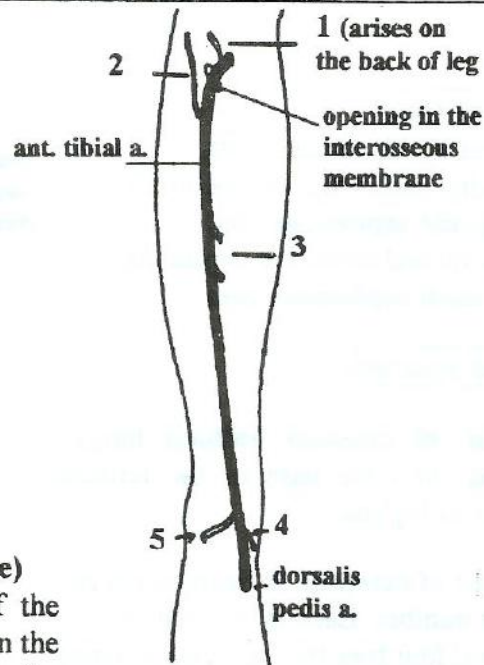
On the back of the leg: The artery gives:

1. **Posterior tibial recurrent artery** which supply the back of the knee joint.

On the front of the leg: The artery gives:

2. **Anterior tibial recurrent artery** which supply the front of the knee joint.
3. **Muscular branches.**
4. **Anterior medial malleolar artery.**
5. **Anterior lateral malleolar arteries.**

The last 2 arteries take part in the malleolar anastomosis.

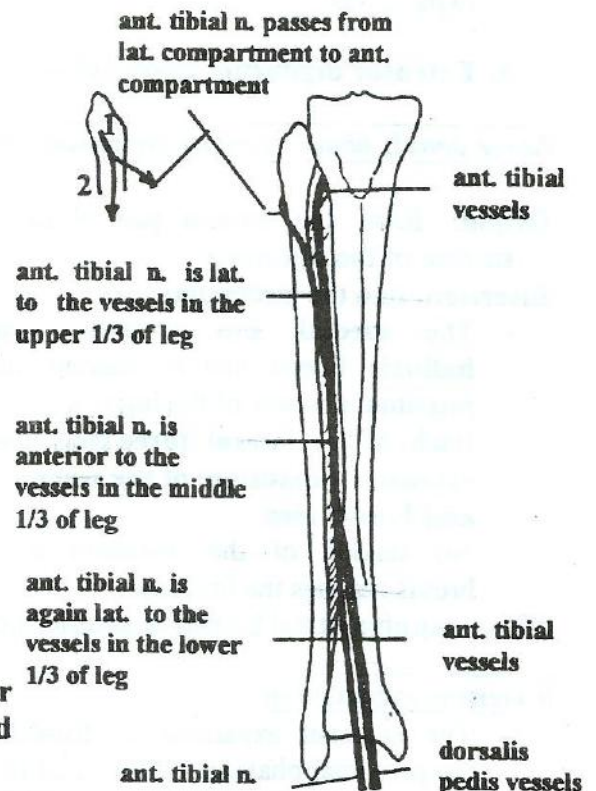
**III. Anterior tibial nerve (deep peroneal nerve)**

Origin: one of the two terminal branches of the lateral popliteal nerve(1), taking origin on the lateral side of the neck of the fibula(2) within the substance of the upper part of peroneus longus muscle (i.e. in the lateral compartment).

Course and relations:

- The nerve pierces the anterior intermuscular septum to reach the anterior compartment.
- It passes through the upper part of extensor digitorum longus.
- Then, it descends deeply in front of the interosseous membrane with the anterior tibial artery.
- In the upper part of the leg: the nerve is lateral to the artery.
- In the middle part of the leg: the nerve becomes anterior to the artery.
- In the lower part of the leg: the nerve becomes lateral to the artery again.
- The nerve then passes in front of the ankle joint to reach the dorsum of the foot.

Branches: supply the tibialis anterior, extensor hallucis longus, extensor digitorum longus and peroneus tertius.

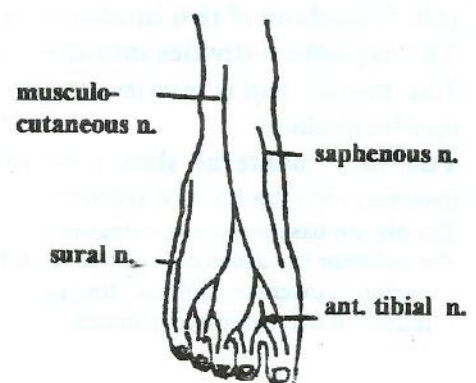
**DORSUM OF THE FOOT****Cutaneous Nerve Supply:**

A. On the dorsum of the foot:

1. Medial part: saphenous nerve.
2. Intermediate part: musculo-cutaneous nerve.
3. Lateral part: sural nerve.

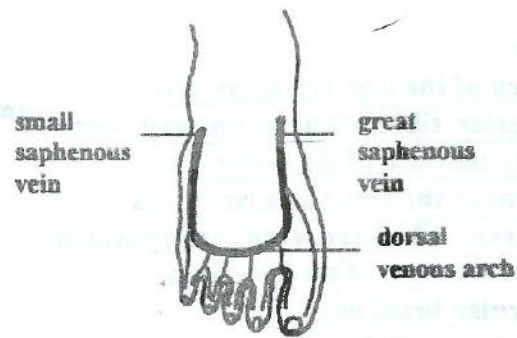
B. On the dorsum of the digits:

1. Sural n.: to the lateral side of little toe.
2. Medial branch of anterior tibial nerve: to the adjoining sides of the big toe and second toe.
3. musculo-cutaneous nerve: to the remainder of the digits.

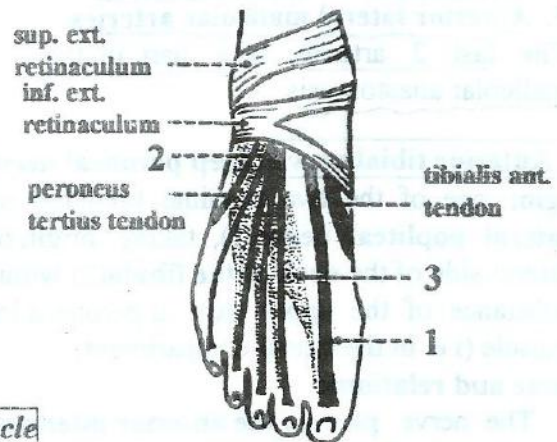


Dorsal venous arch

- Receives dorsal digital veins.
- Its medial end forms the beginning of the great saphenous vein.
- Its lateral end forms the beginning of the small saphenous vein.

**Tendons and muscles**

1. **Tendon of extensor hallucis longus:** Inserted into the base of the terminal phalanx of big toe.
2. **Tendons of extensor digitorum longus:** four in number. Each is inserted into one of lateral four toes through their extensor expansions.
3. **Extensor digitorum brevis muscle:**

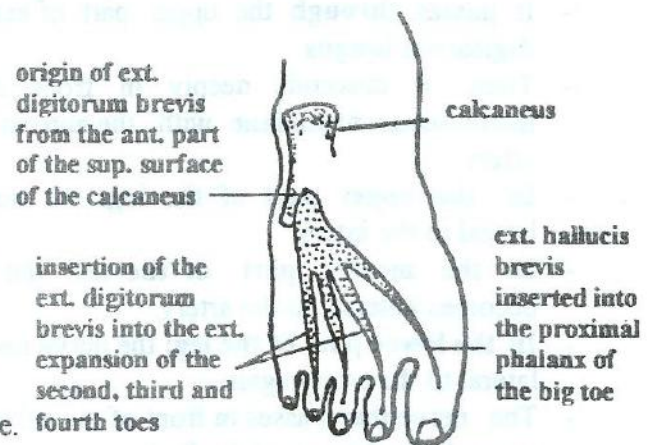
**Some details about extensor digitorum brevis muscle**

Origin: from the anterior part of the upper surface of the calcaneus.

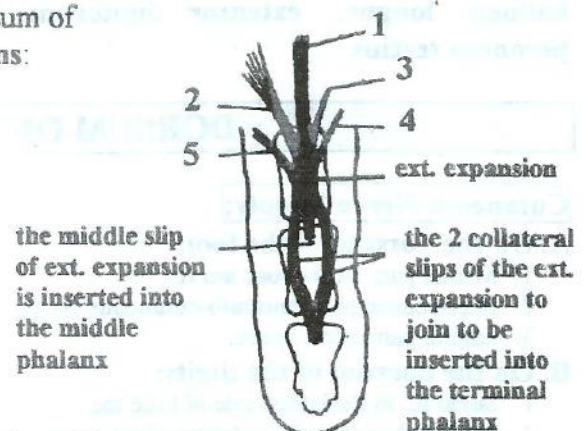
Insertion: into the medial four toes.

- The medial slip is called **extensor hallucis brevis** and is inserted into the proximal phalanx of the big toe.
- Each of the lateral three slips joins the **extensor expansion** of the second, third and fourth toes.
- No tendon of the extensor digitorum brevis reaches the little toe.

Nerve supply: lateral branch of anterior tibial nerve.

**Extensor expansions**

- The extensor expansion is formed on the dorsum of the proximal phalanx by the union of five tendons:
 - (1) tendon of extensor digitorum longus.
 - (2) tendon of extensor digitorum brevis.
 - (3) tendon of one lumbrical muscles.
 - (4&5) tendons of two interossei muscles.
- The expansion divides into three slips.
- The middle slip is inserted into the base of the middle phalanx.
- The two collateral slips join together to be inserted into the base of the terminal phalanx.
- The big toe has no extensor expansion.
- The extensor expansion of the little toe is formed by the union of three tendons:
 1. tendon of extensor digitorum longus.
 2. tendon of one lumbrical muscle.
 3. tendon of one interosseous muscle.



Dorsalis pedis artery

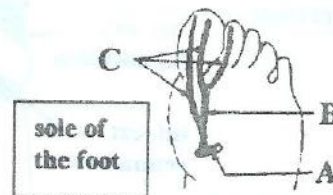
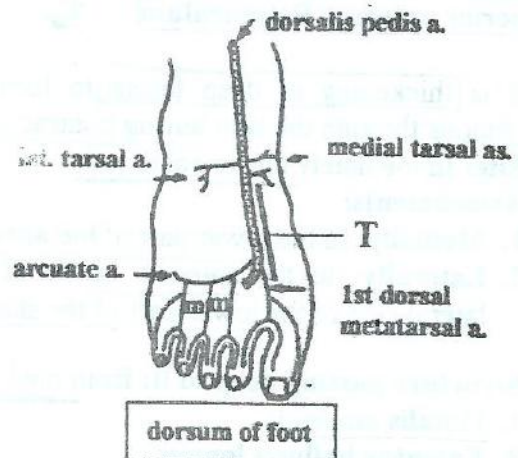
Origin continuation of the anterior tibial artery at ankle joint

Course descends on the dorsum of the foot and then disappears through the first interosseous space into the sole of the foot where it joins the end of the plantar arch.

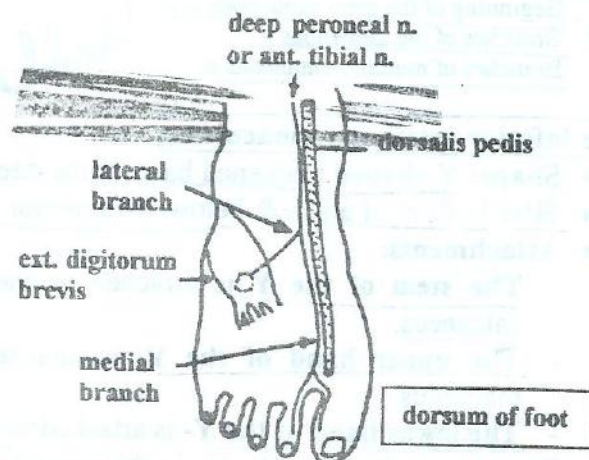
* The tendon of extensor hallucis longus (T) is taken as a guide to feel the pulsations of the dorsalis pedis artery. The artery is just lateral and parallel to the tendon.

Branches

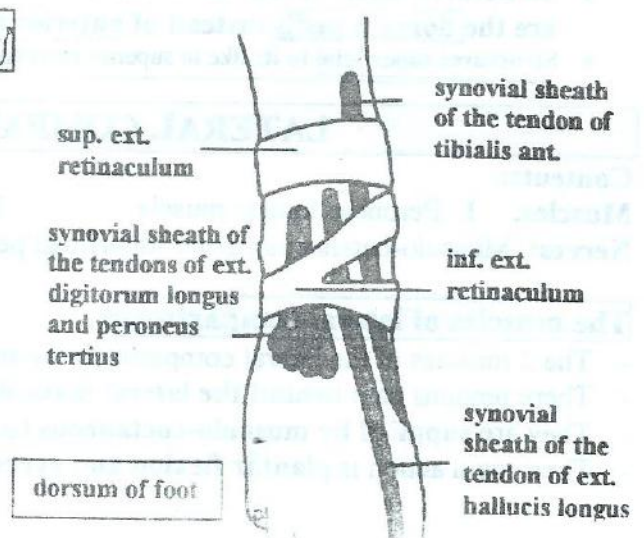
1. lateral tarsal artery.
2. medial tarsal arteries.
3. Arcuate artery: which gives four metatarsal arteries (m). These divide into digital branches for the lateral three and half toes.
4. First dorsal metatarsal artery which supplies the dorsum of the medial one and half toes.
5. First plantar metatarsal artery (A) which arises from the termination of the dorsalis pedis artery (B) in the sole. The artery then divides into: 3 plantar digital arteries (C) to supply the medial side of the big toe and the adjacent sides of the big (1st) toe and 2nd toe.

**Anterior Tibial Nerve (deep peroneal nerve)**

- Runs lateral to the dorsalis pedis artery.
- Divides into:
 - a. Lateral terminal branch: which supplies the extensor digitorum brevis and the joints of the foot. It ends laterally deep to the extensor digitorum brevis.
 - b. Medial terminal branch: which supplies the contiguous sides of the big toe and second toe.

**Synovial sheaths of extensor tendons**

- Surrounds the tendons deep to the retinacula to facilitate their movement.
- The sheath of the tibialis anterior tendon extends from the upper border of the superior extensor retinaculum to the insertion of the muscle.
- The sheath of extensor hallucis longus extends from the lower border of the superior extensor retinaculum to the insertion of the muscle.
- The tendons of extensor digitorum longus and peroneus tertius have a common sheath which begins at the lower border of the superior extensor retinaculum and in the middle of the dorsum of the foot.

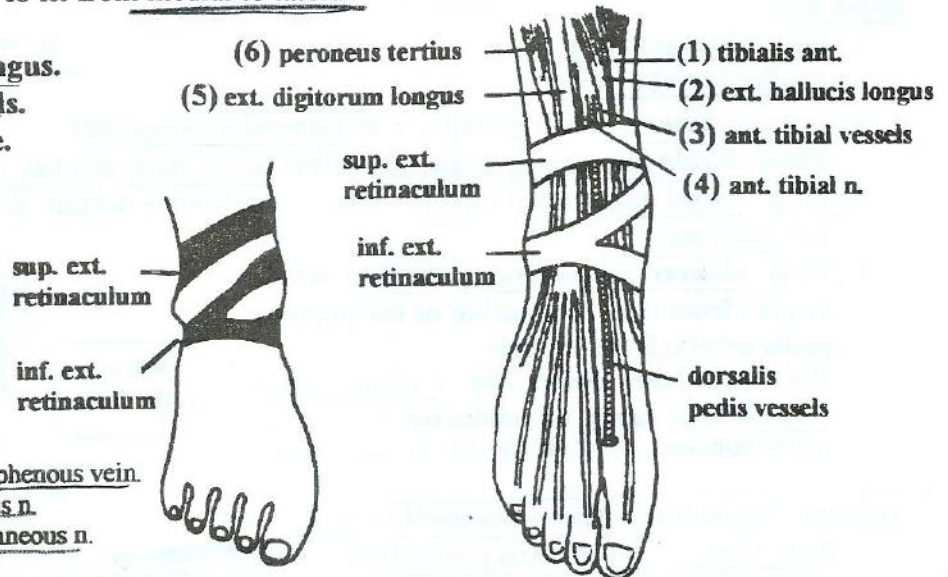


→ Superior extensor Retinaculum



It is thickening of deep fascia to form a fibrous band that prevents projection of the tendons through the skin during contractions of the muscles, and keeps them in position.

- **Site:** Immediately above ankle joint.
- **Attachments:**
 1. **Medially:** to the lower part of the anterior border of tibia.
 2. **Laterally:** to the anterior border of the triangular subcutaneous area on the lateral side of the lower part of the shaft of the fibula.
- **Structure passing deep to it:** from medial to lateral:
 1. Tibialis anterior.
 2. Extensor hallucis longus.
 3. Anterior tibial vessels.
 4. Anterior tibial nerve.
 5. Extensor digitorum longus.
 6. Peroneus tertius.



- **Structures Superficial to it:**
 1. Beginning of the great saphenous vein.
 2. Branches of the saphenous n.
 3. Branches of musculo-cutaneous n.

The Inferior extensor retinaculum:

- **Shape:** Y-shaped thickened band of the deep fascia in front of ankle joint.
- **Site:** In front of ankle & below the superior extensor retinaculum.
- **Attachments:**
 - The stem of the Y is attached to the anterior part of upper surface of calcaneus.
 - The upper band of the Y- is attached to the anterior margin of medial malleolus.
 - The lower band of the Y- is attached to the deep of the sole.
- **Structures deep to it:** as in the superior retinaculum except that the vessels are the dorsalis pedis instead of anterior tibial.
- **Structures superficial to it:** like in superior extensor retinaculum.

LATERAL COMPARTMENT

Contents:

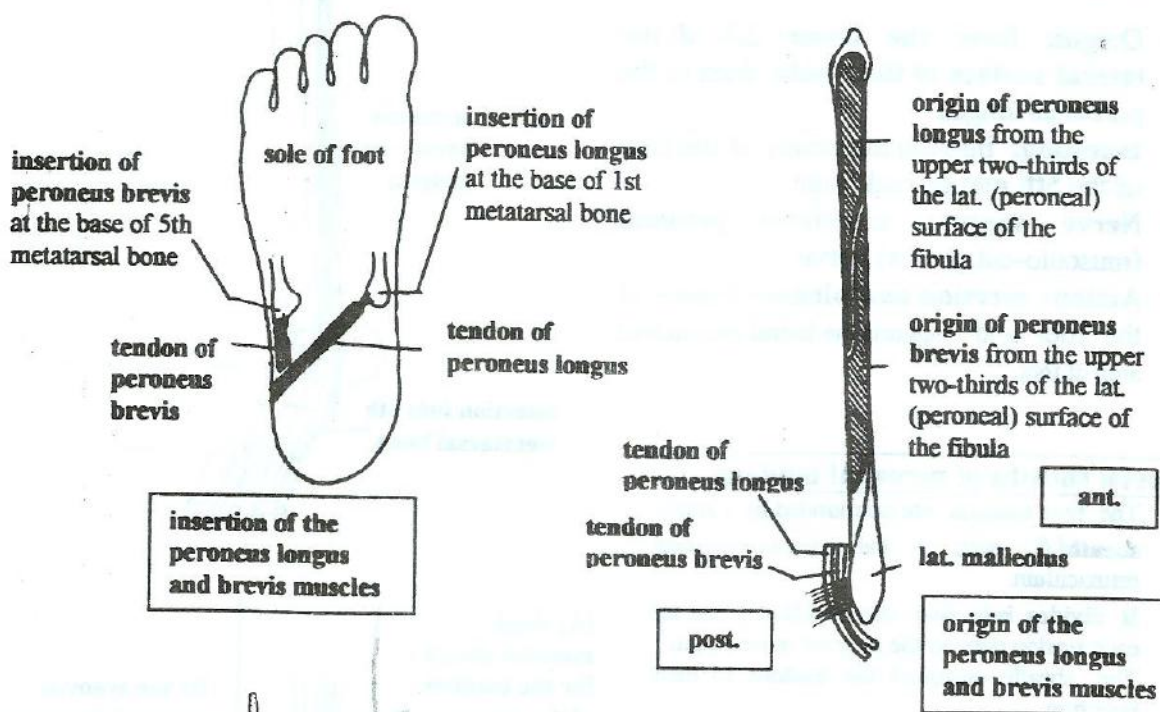
Muscles: 1. Peroneus longus muscle. 2. Peroneus brevis muscle.

Nerves: Musculo-cutaneous (nerve superficial peroneal nerve).

The muscles of lateral compartment

- The 2 muscles of the lateral compartment arise from the lateral surface of fibula.
- Their tendons pass behind the lateral malleolus.
- They are supplied by musculo-coetaneous (superficial peroneal) nerve.
- Their main action is plantar flexion and eversion.

Muscles of lateral compartment

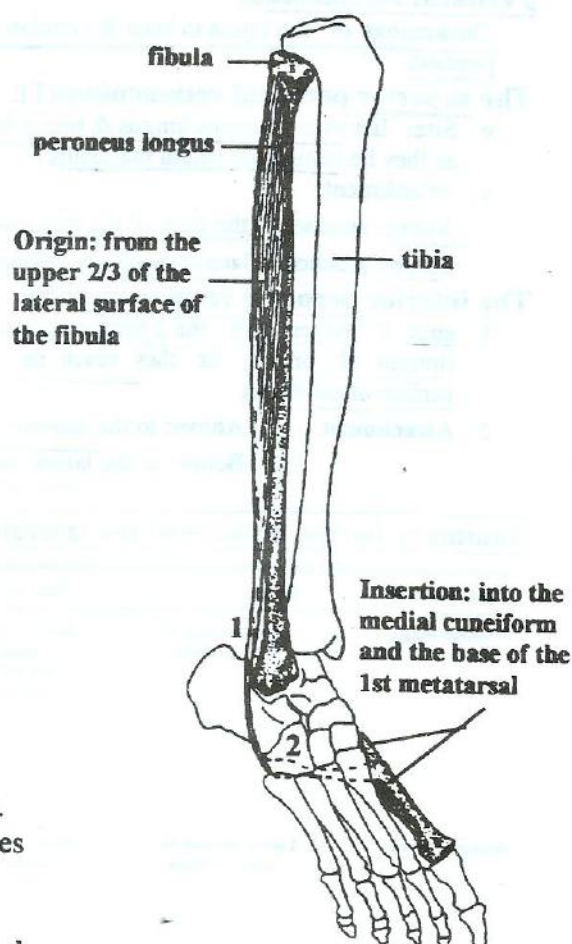


Peroneus longus



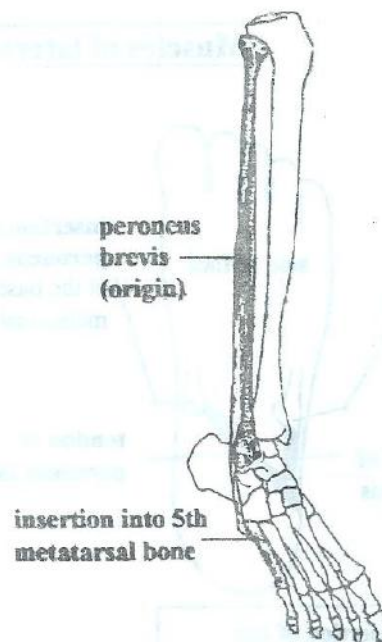
It is longer than the peroneus brevis and has a course in the sole of the foot.

- **Origin:** from the upper 2/3 of the lateral surface of the fibula.
- **Insertion:** into the medial cuneiform and the base of the 1st metatarsal. The tendon of insertion has the following course:
 - (1) It passes at 1st behind then below the lateral malleolus.
 - (2) It then winds round the lateral border of the foot where it lies in a groove on the plantar surface of the cuboid bone.
- **Nerve supply:** superficial peroneal nerve (musculo-cutaneous nerve).
- **Action:**
 1. **Eversion of the foot** (the sole looks laterally). This occurs at the subtalar joint (not the ankle).
 2. **Plantar flexion of the foot** (the foot moves downwards). This movement occurs at the ankle.
 3. It maintains the transverse and lateral longitudinal arches of the foot.



Peroneus brevis

- **Origin:** from the lower 2/3 of the lateral surface of the fibula, deep to the peroneus longus.
- **Insertion:** into the tuberosity of the base of the 5th metatarsal bone.
- **Nerve supply:** superficial peroneal (musculo-cutaneous) nerve.
- **Action:** eversion and plantar flexion of the foot and supports the lateral longitudinal arch of foot.

**Synovial sheaths of peroneal tendons**

- The two tendons are surrounded by a single sheath(A) deep to the superior peroneal retinaculum.
- It divides into two sheaths(B,C), one for each tendon deep to the inferior retinaculum.
- The sheaths surround the tendons to their insertion.

(A) single synovial sheath for the tendons of the peronei longus & brevis

(B) one synovial sheath of the tendon of peroneus longus

(C) one sheath of tendon of peroneus brevis

base of first metatarsal bone

base of fifth metatarsal bone

Peroneal retinaculum

Thickenings of the fascia to keep the tendons in position.

The superior peroneal retinaculum(1):

- **Site:** lies over peroneus longus & brevis tendons as they lie behind the lateral malleolus.
- **Attachment:**

Above: attached to the back of the malleolus(a).

Below: attached to lateral surface of calcaneus(b).

The inferior peroneal retinaculum(2):

1. **site:** It bridges over the 2 peroneal tendons (longus & brevis) as they reach the lat. surface of calcaneus.
2. **Attachment:**
 - Above: to the anterior part of upper surface of calcaneus(c).
 - Below: to the lateral surface of calcaneus(d).

Summary for the muscles of the lateral compartment of the leg

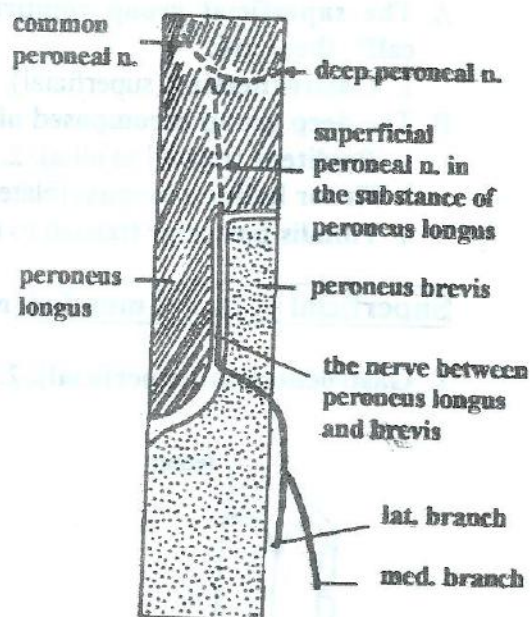
Name of Muscle	Origin	Insertion	Nerve Supply	Action
Peroneus longus	Lateral surface of shaft of fibula	Base of first metatarsal and the medial cuneiform	Superficial peroneal nerve	Plantar flexes foot at ankle joint; everts foot at subtalar and transverse tarsal joints; supports lateral longitudinal and transverse arches of foot
Peroneus brevis	Lateral surface of shaft of fibula	Base of fifth metatarsal bone	Superficial peroneal nerve	Plantar flexes foot at ankle joint; everts foot at subtalar and transverse tarsal joint; supports lateral longitudinal arch of foot

Superficial peroneal nerve (musculo-cutaneous nerve)



Courses and relations:

- It arises on the lateral side of the neck of fibula as one of the 2 terminal divisions of the common peroneal nerve.
- In the upper 1/3 of leg it descends in the substance of the peroneus longus.
- In the middle 1/3 of leg it emerges from the peroneus longus to lie between peroneus longus and brevis.
- In the lower 1/3 of leg it pierces the deep fascia and descends in the superficial fascia crossing superficial to the superior and inferior extensor retinacula to enter the dorsum of the foot.
- The nerve then divide into 2 terminal branches: medial and lateral.



Branches:

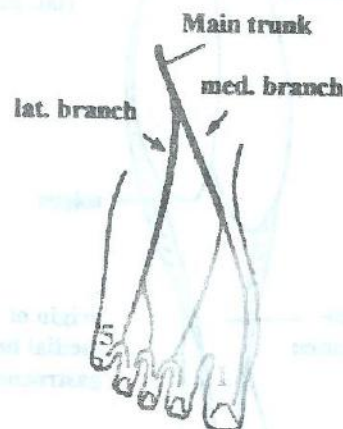
I. Muscular branches: to 2 muscles only.

1. Peroneus longus.
2. Peroneus brevis.

II. Cutaneous branches: (majority)

Are distributed to the skin of the leg (from the main trunk) and foot (from its 2 terminal branches: medial and lateral) as follows:

1. Lower 1/3 of the lateral surface of the leg.
2. The middle part of the dorsum of the foot.
3. The dorsum of the toes except:
 - a. the lateral side of the little (5th) toe (supplied by sural nerve).
 - b. the adjacent sides of the big (1st) and (2nd) toe (supplied by anterior tibial nerve).



Some details about the terminal branches of superficial peroneal nerve

- The medial terminal branch of the superficial peroneal nerve divides into 2 terminal branch:
 1. A branch for the medial side of the big toe.
 2. A branch which divides to supply the contiguous sides of the 2nd and 3rd toes.
- The lateral terminal branch divides into 2 branches:
 1. A branch which divides to supply the contiguous sides of the 3rd and 4th toes.
 2. A branch which divides to supply the contiguous sides of the 4th and little toes.

POSTERIOR COMPARTMENT

Contents:

- **Muscles:** Superficial and deep groups of flexor muscles.
- **Vessels:** Posterior tibial vessels.
- **Nerves:** Posterior tibial nerve (tibial nerve).

Muscles of posterior compartment

These muscles are arranged into a **superficial group** and a **deep group** with the tibial and posterior tibial vessels passing vertically between the 2 groups.

A. The superficial group comprises 3 muscles which form the "muscles of the calf", these are:

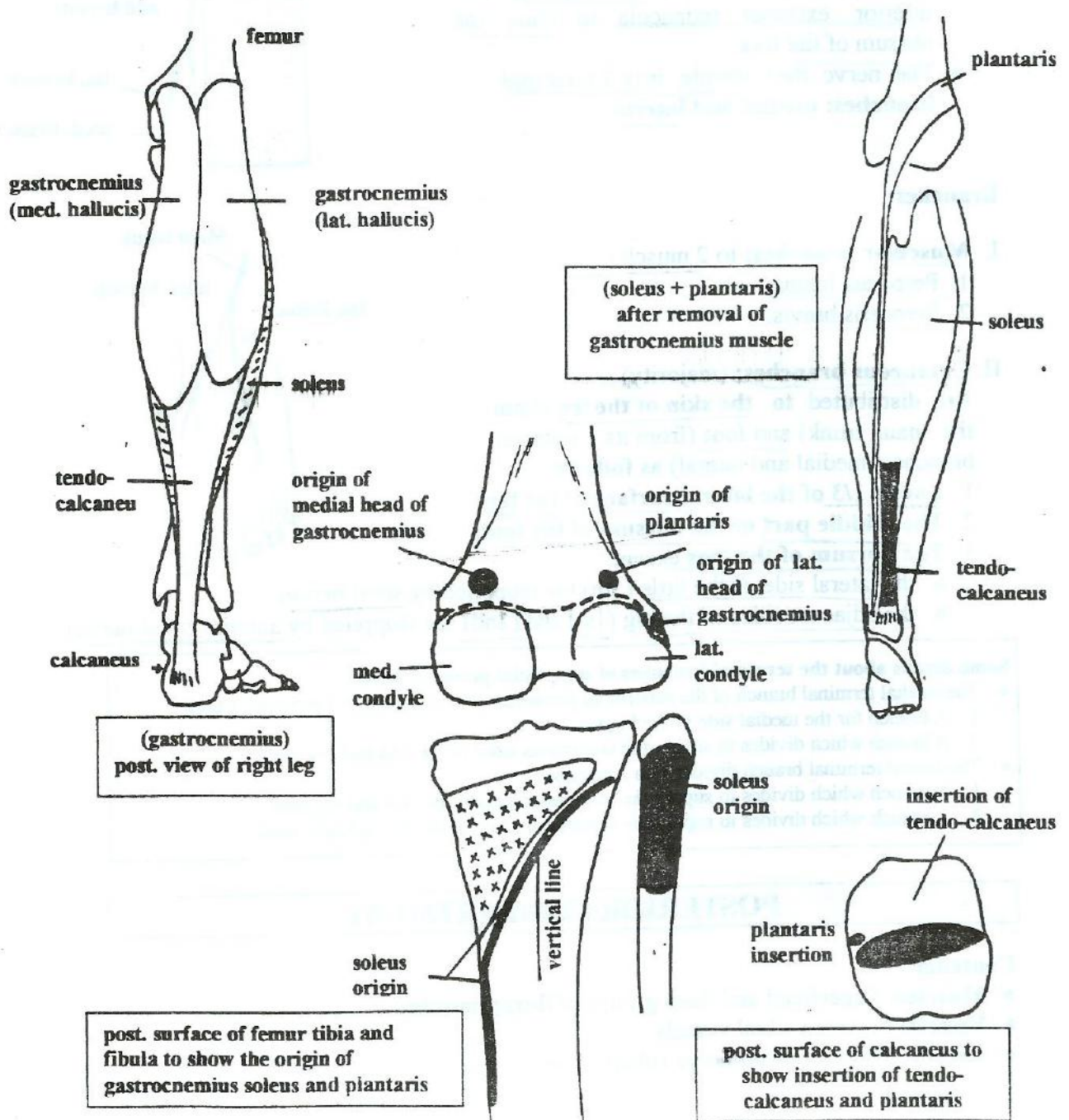
1. **Gastrocnemius** (superficial), 2. **Soleus** (deep), 3. **Plantaris** (in between).

B. The deep group is composed of 4 muscles:

1. **Popliteus** (related to tibia). 2. **Flexor digitorum longus** (related to tibia).
3. **Flexor hallucis longus** (related to fibula).
4. **Tibialis posterior** (related to tibia and fibula).

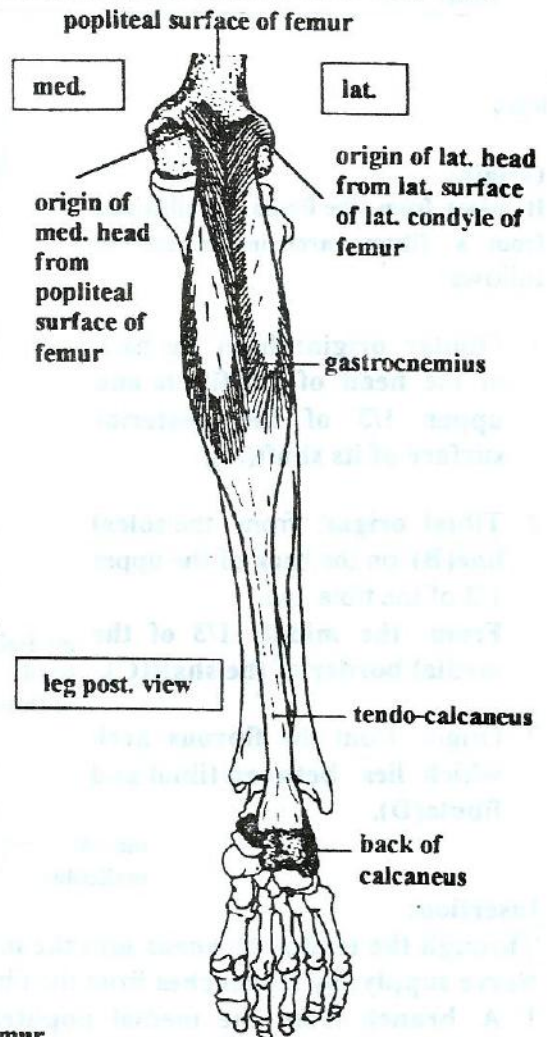
Superficial group of muscles (muscles of the calf)

1. **Gastrocnemius** (superficial), 2. **Soleus** (deep), 3. **Plantaris** (in between).



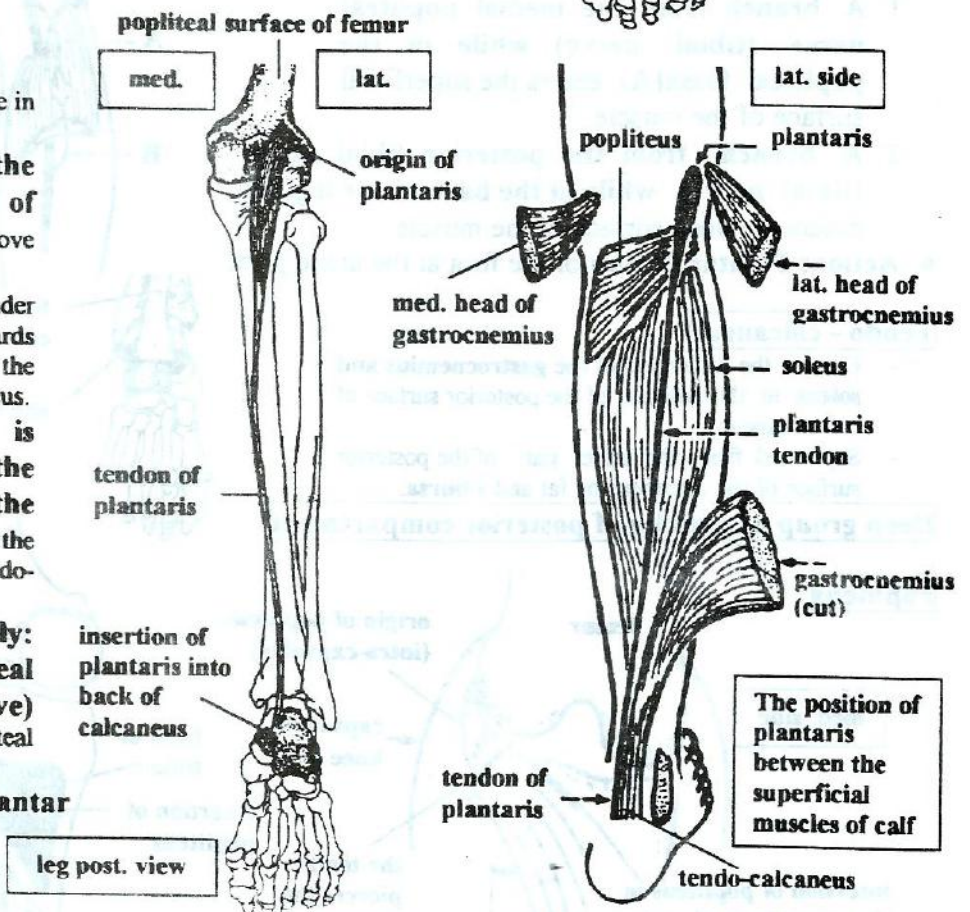
Gastrocnemius

- **Origin:** arises by 2 heads (medial and lateral).
 1. **Medial head:** from the **popliteal surface of the femur** just above the medial femoral condyle.
 2. **Lateral head:** from the **lateral surface of the lateral condyle of femur** just above and behind the lateral epicondyle.
- **Insertion:**
The 2 bellies of the muscle end in a tendon which joins the tendon of the soleus to form together the **tendo-calcaneus** which is inserted into the **middle of back of calcaneus**.
This thick strong tendon is separated from the upper part of the back of the calcaneus by a bursa.
- **Nerve supply:**
Medial popliteal nerve (tibial nerve) while in the popliteal fossa (a branch to each head).
- **Action:**
 1. Together with the soleus, the muscle is a **powerful plantar flexor of the foot**.
 2. Gastrocnemius can also flex the knee joint.

**Plantaris**

It is a rudimentary muscle in man and may be absent.

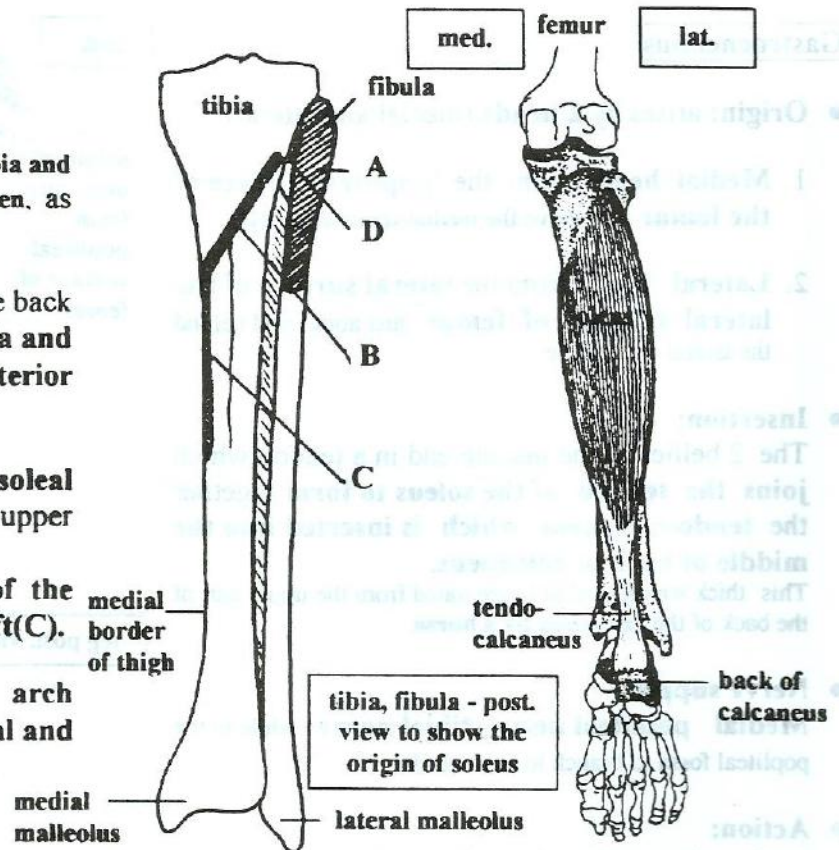
- **Origin:** from the **popliteal surface of the femur** just above the lateral condyle.
- **Insertion:** its slender tendon passes downwards between the gastrocnemius and soleus. The tendon is inserted into the **back of the calcaneus** medial to the insertion of tendo-calcaneus.
- **Nerve supply:** **medial popliteal nerve (tibial nerve)** while in the popliteal fossa.
- **Action:** helps in **plantar flexion of the foot**.



Soleus● **Origin:**

It arises from the fibula and tibia and from a fibrous arch in between, as follows:

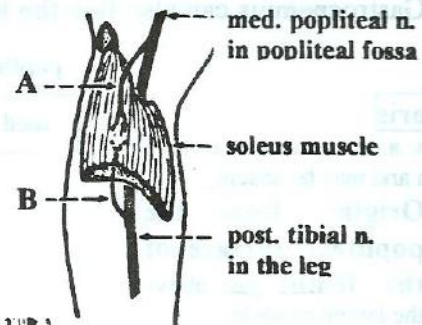
1. **Fibular origin:** from the back of the head of the fibula and upper 1/3 of the posterior surface of its shaft(A).
2. **Tibial origin:** from the soleal line(B) on the back of the upper 1/3 of the tibia and, From the middle 1/3 of the medial border of the shaft(C).
3. Origin from the fibrous arch which lies between tibial and fibula(D).

● **Insertion:**

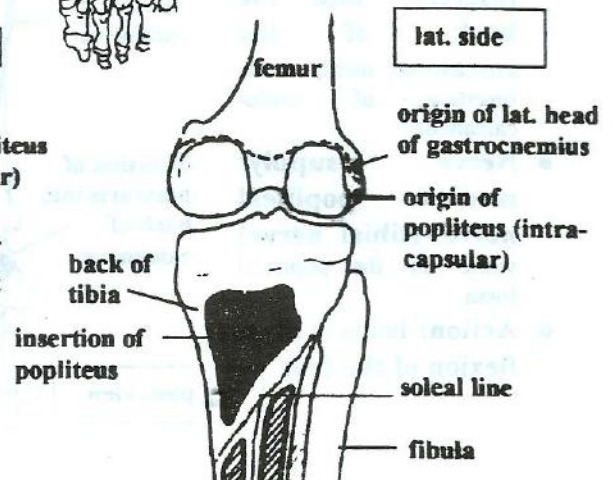
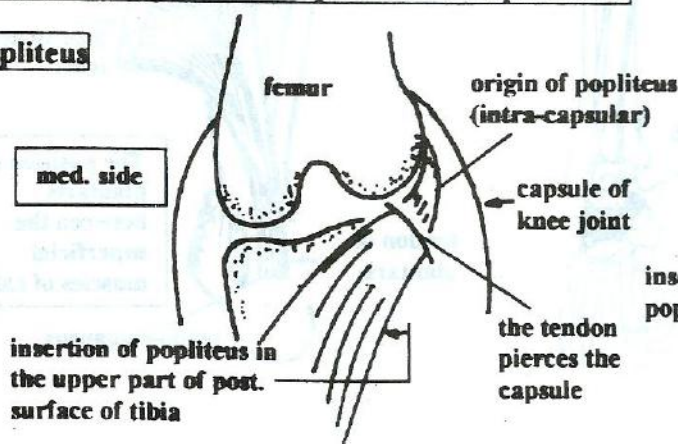
Through the tendo-calcaneus into the middle of the back of the calcaneus.

● **Nerve supply:** by 2 branches from the tibial nerve:

1. A branch from the medial popliteal nerve (tibial nerve) while in the popliteal fossa(A): enters the superficial surface of the muscle.
2. A branch from the posterior tibial nerve (tibial nerve) while in the back of the leg(B): enters the deep surface of the muscle.

● **Action:** Plantar flexion of the foot at the ankle joint.**Tendo - calcaneus**

- Carries the insertion of the gastrocnemius and soleus to the middle of the posterior surface of the calcaneus.
- Separated from the upper part of the posterior surface of the calcaneus by fat and a bursa.

**Deep group of muscles of posterior compartment****Popliteus**

- **Origin of popliteus:** Intracapsular - from the **anterior** part of the groove for popliteus (which lies on the lateral surface of the lateral condyle of the femur just below the lateral epicondyle).
- **Insertion:** into the upper part of the **posterior surface of the tibia** above the soleal line.
- **Nerve supply:** **medial popliteal nerve (tibial nerve)** while in the popliteal fossa.
- **Action:**
 - Flexion of the knee.
 - Medial rotation of the leg on femur.
 - Lateral rotation of femur on the leg.
 - The muscle initiates unlocking of knee joint at the beginning of flexion.

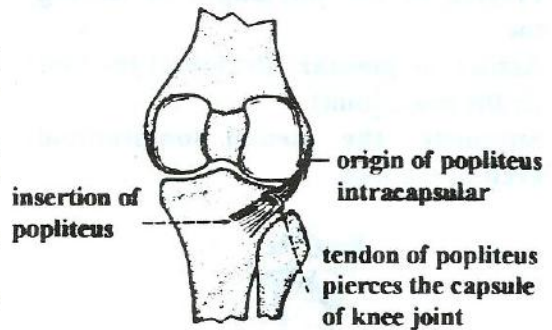
N.B.:

The popliteus muscle lies on the Upper part of the back of tibia just **above the soleal line**.

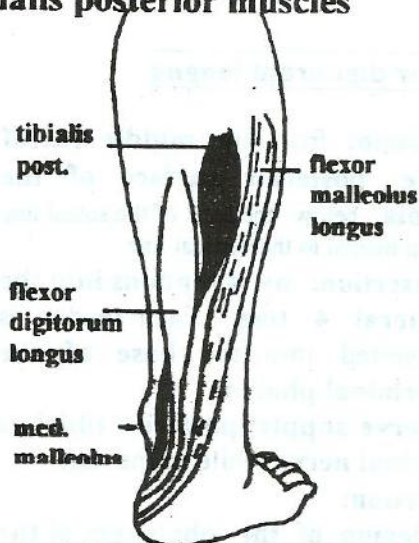
It forms the lower part of the floor of the popliteal fossa, and is covered by a thick popliteal fascia.

The tendon of popliteus lies inside the capsule of the joint.

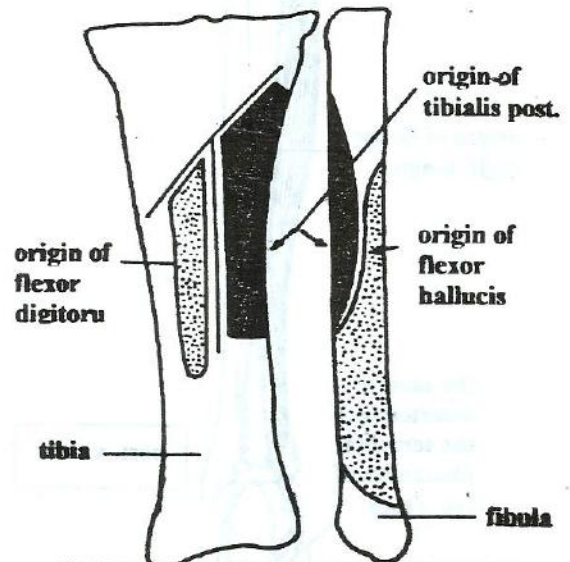
It emerges on the back of the capsule through a perforation to reach its insertion.



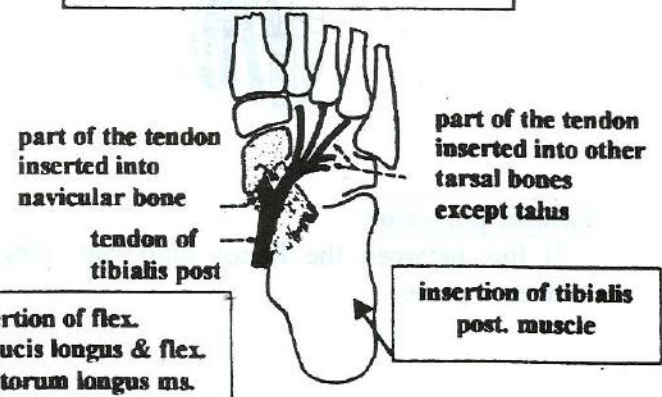
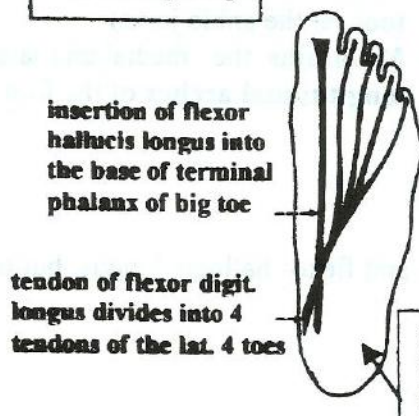
Deep muscles of leg: flexor hallucis longus, flexor digitorum longus & tibialis posterior muscles



Deep muscles of back of right leg

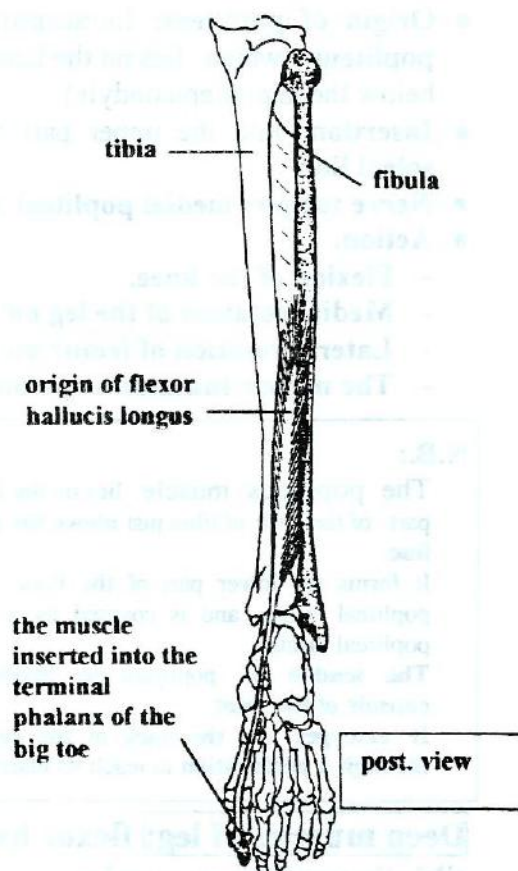
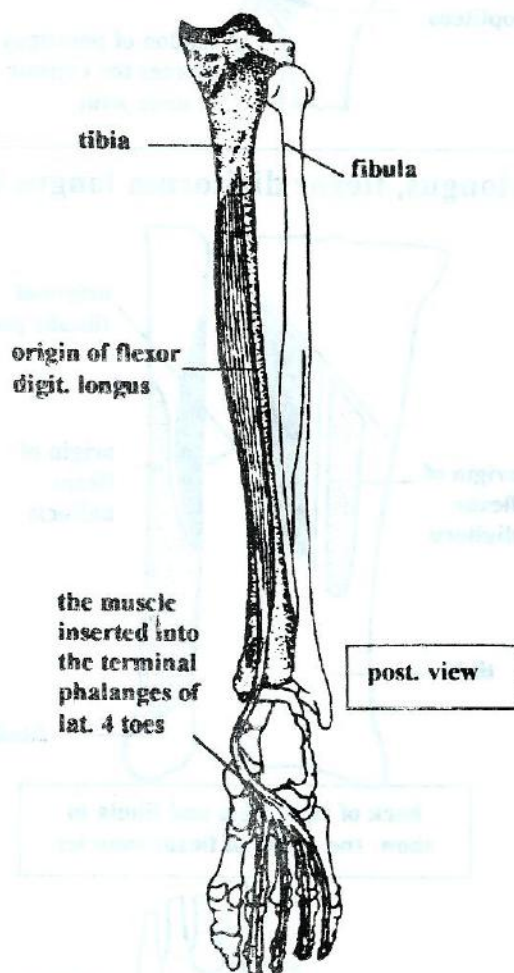


back of right tibia and fibula to show the origin of flexor muscles



Flexor hallucis longus

- **Origin:** from the distal 2/3 of the posterior surface of the fibula (below the origin of the soleus).
- **Insertion:** into the plantar surface of the base of the terminal phalanx of the big toe.
- **Nerve supply:** posterior tibial nerve (tibial nerve while in the leg).
- **Action:**
 1. Flexion of the phalanges of the big toe.
 2. Assists in plantar flexion of the foot (at the ankle joint).
 3. Supports the medial longitudinal arch of the foot.

**Flexor digitorum longus**

- **Origin:** from the middle 1/3 of the posterior surface of the tibia, below the level of the soleal line and medial to the vertical line.
- **Insertion:** by 4 tendons into the lateral 4 toes. Each tendon is inserted into the base of the terminal phalanx.
- **Nerve supply:** posterior tibial nerve (tibial nerve while in the leg).
- **Action:**
 1. Flexion of the phalanges of the lateral 4 toes.
 2. Assists in plantar flexion of the foot (at the ankle joint).
 3. Maintains the medial and lateral longitudinal arches of the foot.

Tibialis posterior

It lies between the flexor digitorum longus and flexor hallucis longus, but on a deeper plane.

- **Origin of tibialis posterior:**

1. From the posterior surface of the interosseous membrane.
2. From the upper 2/3 of the back of the tibia lateral to the vertical line (below the soleal line).
3. From the upper 2/3 of the back of the fibula.

- **Insertion: into:**

1. Tuberosity of navicular bone (main insertion).
2. All other tarsal bones except the talus.
3. Bases of 2nd, 3rd and 4th metatarsal bones.

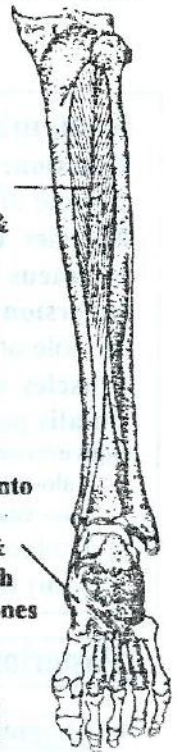
- **Nerve supply:** posterior tibial nerve (tibial nerve) in the leg).

- **Action:**

1. Inverts the foot (at the subtalar joint).
2. Assists in plantar flexion of the foot (at the ankle joint).
3. Maintains the medial longitudinal arch of the foot.

origin of
tibialis post.
from back of
tibia, fibula &
interosseous
membrane

insertion of
tibialis post. into
tarsal bones
except talus &
2nd, 3rd & 4th
metatarsal bones



Summary for the muscles of the posterior compartment of the leg

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Superficial Group				
Gastrocnemius	Lateral head from lateral condyle of femur and medial head from above medial condyle	Via tendo calcaneus into posterior surface of calcaneum	Tibial nerve	Plantar flexes foot at ankle joint; flexes knee joint
Plantaris	Lateral supracondylar ridge of femur	Posterior surface of calcaneum	Tibial nerve	Plantar flexes foot at ankle joint; flexes knee joint
Soleus	Shafts of tibia and fibula	Via tendo calcaneus into posterior surface of calcaneum	Tibial nerve	together with gastrocnemius and plantaris is powerful plantar flexor of ankle joint; provides main propulsive force in walking and running
Deep Group				
Popliteus	Lateral surface of lateral condyle of femur	Posterior surface of shaft of tibia above soleal line	Tibial nerve	flexes leg at knee joint; unlocks knee joint by lateral rotation of femur on tibia
Flexor digitorum longus	Posterior surface of shaft of tibia	Bases of distal phalanges of lateral four toes	Tibial nerve	flexes distal phalanges of lateral four toes; plantar flexes foot at ankle joint; supports medial and lateral longitudinal arches of foot
Flexor hallucis longus	Posterior surface of shaft of fibula	Base of distal phalanx of big toe	Tibial nerve	flexes distal phalanx of big toe; plantar flexes foot at ankle joint; supports medial longitudinal arch of foot
Tibialis posterior	Posterior surface of shafts of tibia and fibula and interosseous membrane	Tuberosity of navicular bone and other neighboring bones	Tibial nerve	Plantar flexes foot at ankle joint; inverts foot at subtalar and transverse tarsal joints; supports medial longitudinal arch of foot

Remember that about eversion and inversion

Eversion: is the movement of turning the sole of the foot laterally.

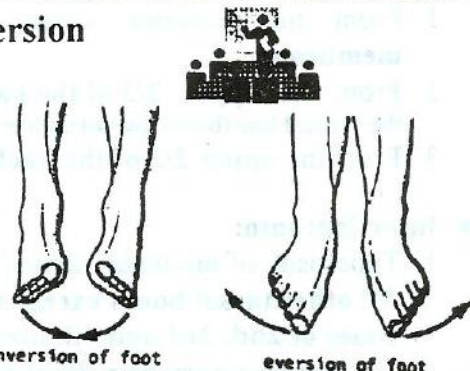
Muscles concerned: peroneus longus, peroneus brevis & peroneus tertius.

Inversion: is the movement of turning the sole of the foot medially.

Muscles concerned: tibialis anterior & tibialis posterior.

Both eversion and inversion occur at several joints:

- Talo-calcaneal (subtalar joint), talo-navicular & calcaneo-cuboid (mid tarsal joint) and talo-calcaneo-navicular joints.
- Collectively we say **eversion and inversion** occur at **talo-calcaneo-navicular joint** which is synovial joint and resemble ball and socket.



Posterior tibial artery

- **Origin** the larger of the two terminal branches of the **popliteal artery** at the distal border of popliteus.

Course and relations:

• Superficial relations:

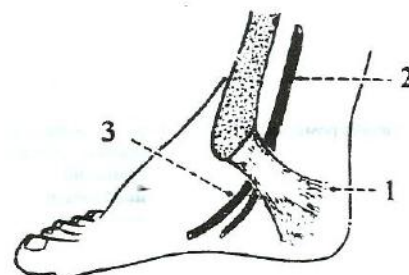
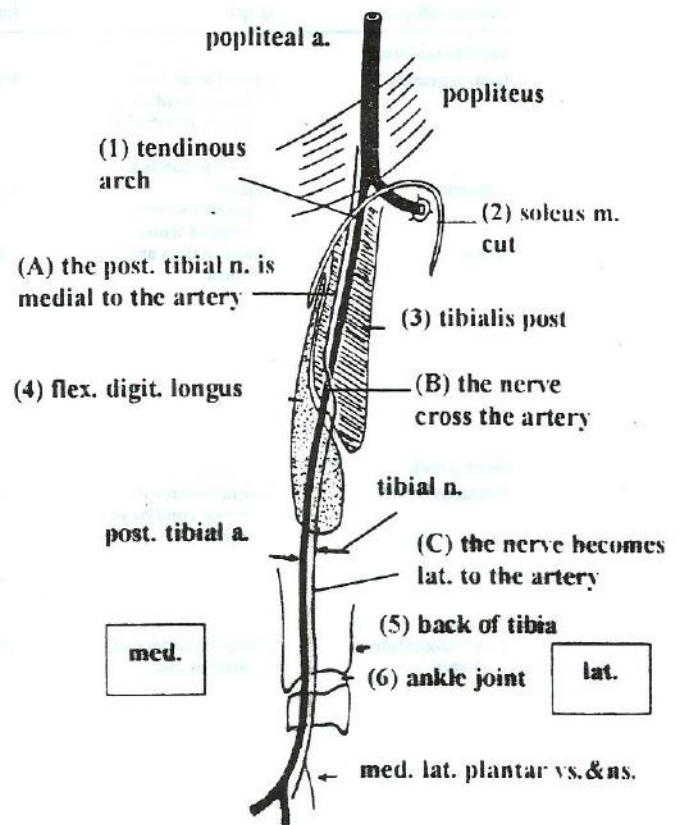
- The artery passes deep under cover of the tendinous arch(1) between the tibia and fibula.
- Then it descends deep to the soleus muscle(2).
- In the lower part of the leg the artery becomes more superficial. It is only covered by the skin, superficial fascia and deep fascia.

• Deep relations:

- From above downwards the artery passes in front of **tibialis posterior muscle(3)**, **flexor digitorum longus muscle(4)**, **posterior surface of tibia(5)** & **back of ankle joint(6)**.
- The **posterior tibial nerve** is **medial to it(A)** in the upper part of the leg.
- Then, it crosses(B) behind the artery to continue along its lateral side(C).
- Along its course the **posterior tibial artery** is accompanied by two venae comitantes.

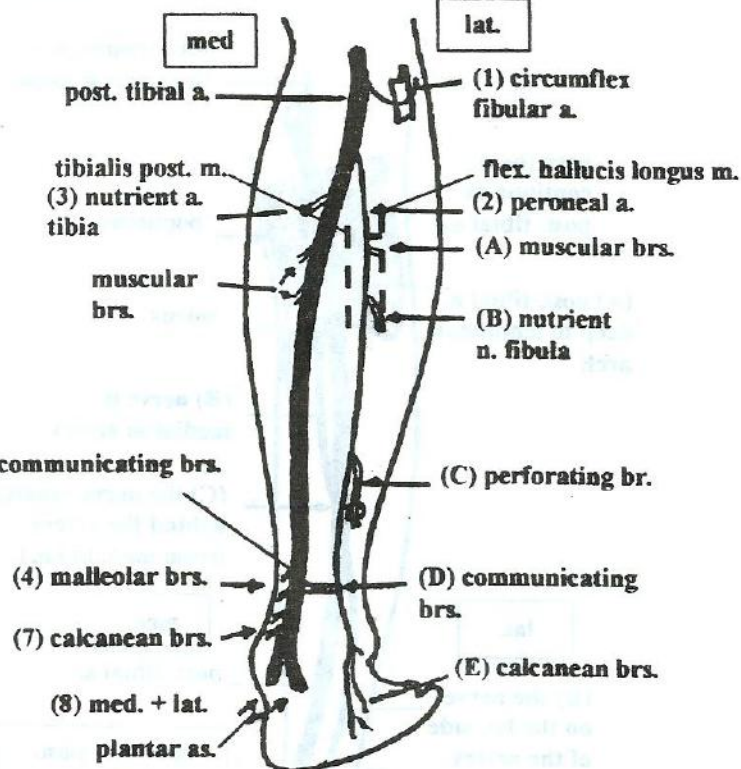
• Termination:

- Under cover of the **flexor retinaculum(1)**, The **posterior tibial artery(2)** terminates by dividing into **medial and lateral plantar arteries(3)**.



Branches of posterior tibial artery:

- (1) **Circumflex fibular artery:** which runs round the neck of the fibula.
- (2) **Peroneal artery:** which supplies the lateral muscles of the posterior compartment (described later).
- (3) **Nutrient artery to the tibia.**
- (4) **Muscular branches.**
- (5) **A communicating branch** with the peroneal artery.
- (6) **Malleolar branch** which runs on the medial malleolus.
- (7) **Calcanean branches** to the heel.
- (8) **Terminal branches:** medial and lateral plantar arteries.

**Peroneal artery(2):**

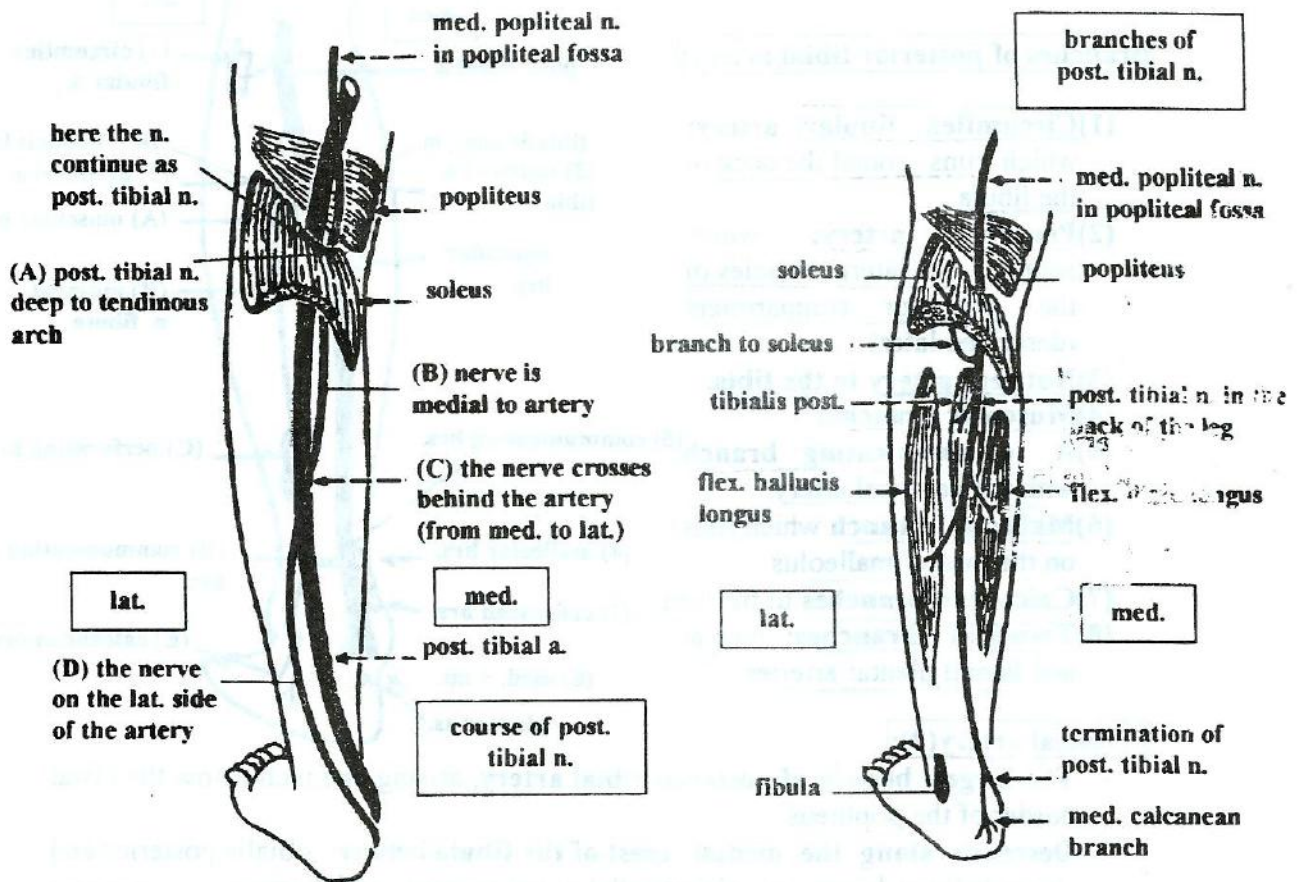
- The largest branch of posterior tibial artery, arising one inch below the distal border of the popliteus.
- Descends along the medial crest of the fibula between tibialis posterior and flexor hallucis longus muscles parallel to the posterior tibial artery.
- Terminates behind the inferior tibio-fibular joint by giving terminal calcanean branches(E).
- It gives the following branches:
 1. Muscular branches(A) to the lateral muscles of the posterior compartment.
 2. Nutrient artery to the fibula(B).
 3. Perforating branch(C): which pierces the interosseous membrane two inches above the ankle to reach the anterior compartment. This artery may be enlarged to replace the dorsalis pedis artery.
 4. A communicating branch(D) with the posterior tibial artery.
 5. Terminal calcanean branches(E) on the lateral side of the calcaneus.

Posterior tibial nerve(tibial nerve)

- **Origin:** continuation of medial popliteal nerve at the distal border of popliteus.

Course and relations:

- Passes deep to the tendinous arch(A) between the tibia and fibula.
- Descends deep to the soleus muscle between it and the deep muscles.
- At first it lies medial(B) to the posterior tibial artery.
- Then, it crosses behind the artery(C) and descends on its lateral side(D) for the greater part of its course.
- In the lower part of the leg it is only covered by the skin, superficial fascia and deep fascia.
- It terminates deep to the flexor retinaculum by dividing into medial and lateral plantar nerves.



Branches:

1. **Muscular** to the deep surface of soleus, flexor digitorum longus, tibialis posterior and flexor hallucis longus.
2. Articular branch to the ankle joint.
3. **Medial calcaneal branches**: pierce the flexor retinaculum to supply the overlying skin.
4. **Terminal branches**: medial and lateral plantar nerves.

→ Flexor Retinaculum

This is a thickened band of deep fascia on the medial side of the ankle, behind and below the medial malleolus.

Attachments:

Above: To the medial malleolus.

Below: To the medial border of posterior surface of calcaneus.

Order of structures from medial to lateral under cover of the retinaculum is:

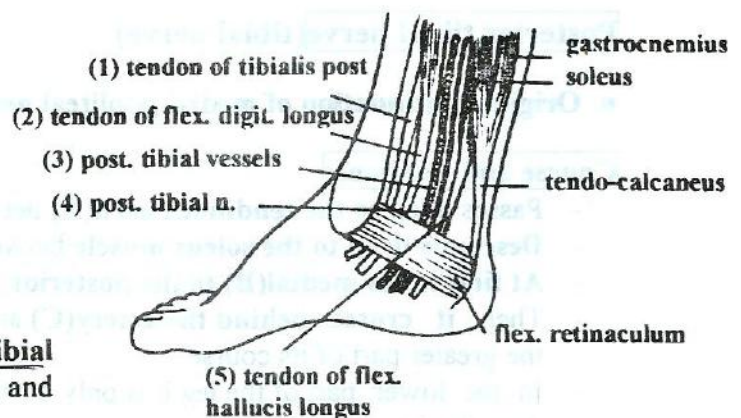
(1) Tibialis posterior.

(2) Flexor digitorum longus.

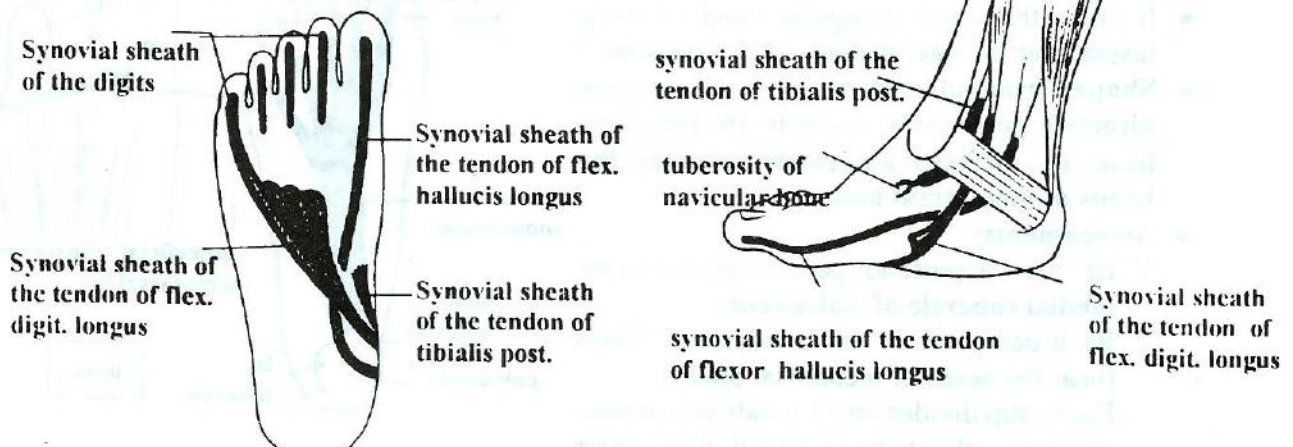
(3) Termination of posterior tibial vessels and beginning of medial and lateral plantar vessels.

(4) Termination of posterior tibial nerve and beginning of medial and lateral plantar nerves.

(5) Flexor hallucis longus.



Synovial sheaths of flexor tendons



1. **Sheath of tibialis posterior:** begins one inch above the flexor retinaculum and ends at the navicular bone.
2. **Sheath of flexor digitorum longus:** begins one inch above the flexor retinaculum and ends in the middle of the foot. It is continuous with the sheath of the little toe. The sheaths of the second, third and fourth toes are not continuous with the sheath.
3. **Sheath of flexor hallucis longus:** begins one inch above the flexor retinaculum and extends to the insertion of the muscle.

THE FOOT

Functions:

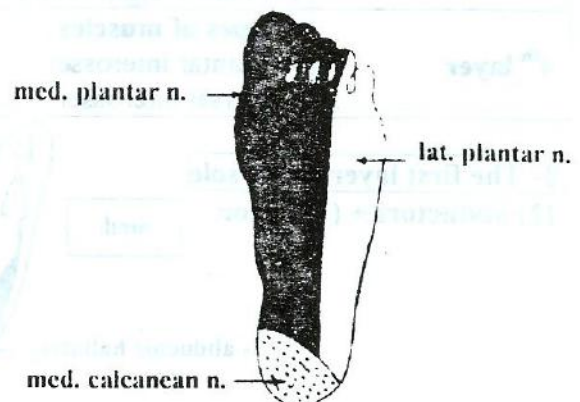
1. Provides a rigid support for the body weight in standing.
2. Acts as a movable spring-like structure in walking.

Sole of the foot

1. **The superficial fascia:** Contains a dense amount of fat and cutaneous nerves & vessels.
2. **The deep fascia:** Is divided into 3 parts:
 - a. **Medial part** which covers the abductor hallucis muscle.
 - b. **Lateral part** which covers the abductor digiti minimi muscle.
 - c. A very strong & dense **intermediate part** called **plantar aponeurosis**.

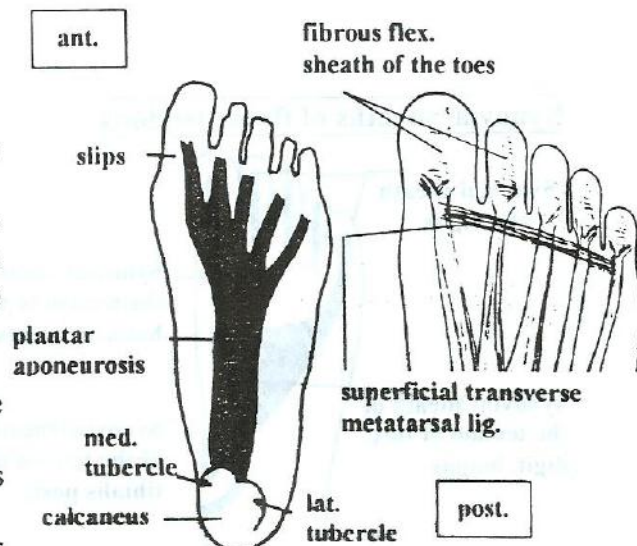
Cutaneous nerves

- **The skin the sole:**
 1. **The skin of the heel:** is supplied by **medial calcaneal** branch of posterior tibial nerve.
 2. **The skin of the plantar structure of the foot:**
 - a. **Medial 2/3:** is supplied by **medial plantar nerve**.
 - b. **Lateral 1/3:** is supplied by **lateral plantar nerve**.
- **Skin of the plantar surface of the toes:**
 1. **Medial 3½ toes:** is supplied by **medial plantar nerve**.
 2. **Lateral 1½ toes:** is supplied by **lateral plantar nerve**.



Plantar aponeurosis

- It is a thickened triangular band of deep fascia over the intermediate part of the sole.
- **Shape:** triangular in shape with its apex directed posteriorly towards the heel & its base is directed anteriorly towards the heads of metatarsal bones.
- **Attachments:**
 1. Its narrow posterior part is attached to the medial tubercle of calcaneus.
 2. Its broad anterior end divides into 5 slips (near the heads of metatarsal bones). Each slip divides into 2 bands which pass towards the toes to blend with their fibrous flexor sheaths.



N.B.: The superficial transverse metatarsal ligament of the sole is formed of transverse fibers connecting the 5 slips of the plantar aponeurosis.

- **Function of plantar aponeurosis:** (1) It maintains the longitudinal arches of the foot. (2) Protects underlying vessels & nerves.

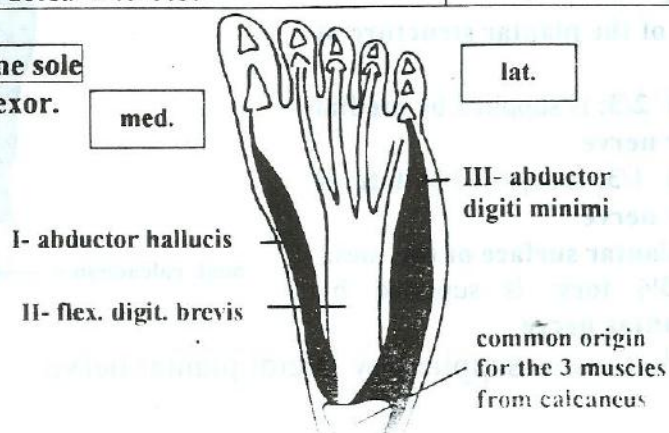
Layers of the sole of foot

The muscles & ligaments of the sole are arranged in 4 layers separated by layers of fascia in which plantar vessels & nerves lie.

Layers	Muscles	Tendons
1 st layer	3 muscles (2 abductor + 1 flexor) - Abductor hallucis - Abductor digiti minimi - Flexor digitorum brevis	--
2 nd layer	2 types of muscles - 4 lumbrical muscles + - Flexor digitorum accessorius (quadratus plantae)	2 tendons Flexor hallucis longus Flexor digitorum longus
3 rd layer	3 muscles (2 flexor + 1 adductor) (1) Adductor hallucis (2) Flexor hallucis brevis (3) Flexor digiti minimi brevis	--
4 th layer	2 types of muscles - 3 plantar interossei - 4 dorsal interossei	2 tendons

I- The first layer of the sole

(2) abductors + (1) flexor.



I- The first layer of the sole

Muscle	Origin	Insertion	Nerve supply	action
I. Abductor hallucis	Common origin from med. tubercle of calcaneus	By a strong tendon into the medial side of base proximal phalanx of the great toe.	Medial plantar n.	(1) Abducts the great toe (from the 2nd toe). (2) Maintains the medial longitudinal arch of foot.
II. Flexor digitorum brevis		4 tendons to the middle phalanges of the lateral 4 toes.		Flexion of metatarso phalangeal & proximal inter phalangeal joints of the lateral 4 toe.
III. Abductor digiti minimi		Lateral side of the base of the proximal phalanx of the little toe	Lateral plantar nerve	Abducts the little toe.

II. The Second Layer of the Sole**A. 2 tendons + 2 muscles****- The tendons are:**

- tendon of flexor digitorum longus &
- flexor hallucis longus.

- The muscles are:

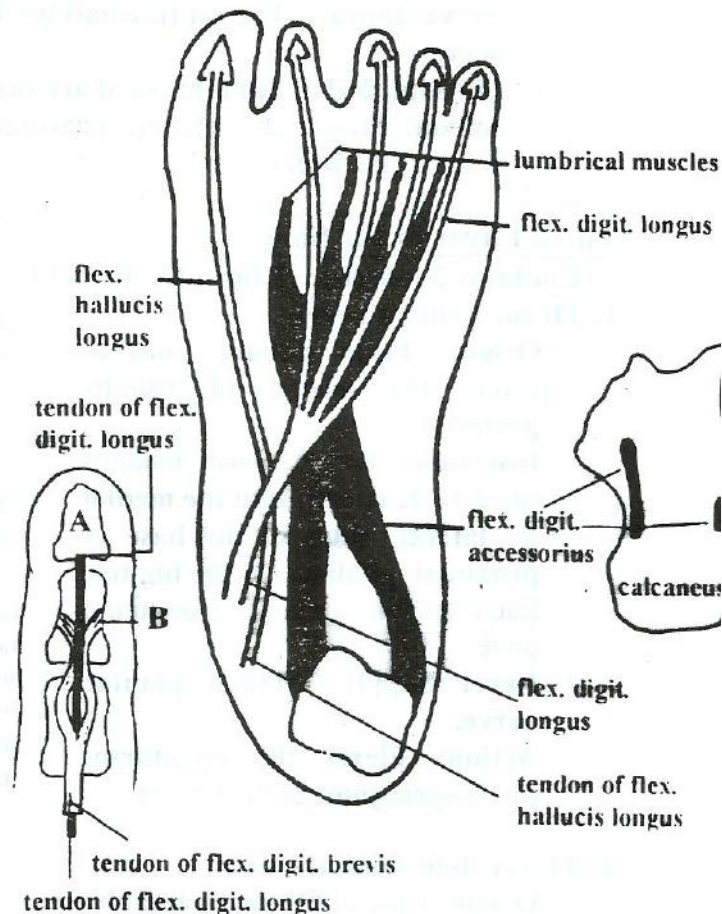
- 4 lumbrical &
- flexor digitorum accessorius.

A. 2 Tendons:**1. Tendons of flexor digitorum longus.**

- Crosses superficial to the tendon of flexor hallucis longus.
- **Divides into 4 slips** passing to their insertion in the bases of **terminal phalanges(A)** of the lateral 4 toes.
- To reach their insertion, they **perforate the tendons of flexor digitorum brevis(B)**.

2. Tendon of flexor hallucis longus.

- **Passes deep to the tendon of flexor digitorum longus**
- It is inserted into **plantar surface of base of the distal phalanx of the great toe**



B. 2 Types of Muscles:

1. Flexor digitorum accessories (quadratus plantae) muscle:

- **Origin:** arises by 2 heads:
 - **medial head:** from medial surface of calcaneus
 - **lateral head:** from lateral margin of the inferior (plantar) surface of calcaneus.
- **Insertion:** into the tendon of flexor digitorum longus.
- **Nerve supply:** lateral plantar nerve.
- **Action:**
 - It flex the toes when the foot in plantar flexion.
 - It corrects the oblique line of pull of the flexor digitorum longus tendon.

2. Four lumbrical muscles:

- **Origin:** From the tendons of flexor digitorum longus as follows:
 1. **First lumbrical:** takes origin from the medial side of the tendon for the 2nd toe.
 2. **Lateral 3 lumbricals:** take origin from the adjacent sides of 2 tendons of flexor digitorum longus.
- **Insertion:** The 4 tendons pass upwards across the medial side of the metatarso-phalangeal joints to blend with the extensor expansions and the proximal phalanges of the lateral 4 toes
- **Nerve supply:** The 1st (medial) lumbrical is supplied by medial plantar nerve.
- **The 2nd, 3rd & 4th lumbrical are supplied by lateral plantar nerve.**
- **Action:** Flexor of metatarso-phalangeal and extension of inter-phalangeal joints of the lateral 4 toes.

Third Layer of the Sole

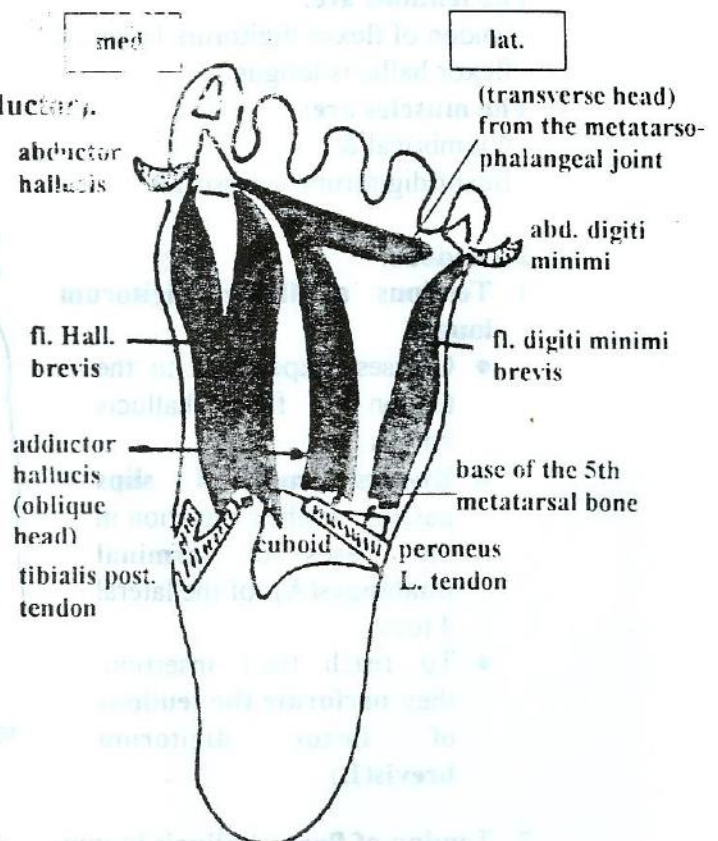
Contains 3 muscles: (2 flexor & one adductor).

1. Flexor hallucis brevis

- **Origin:** From cuboid bone & from the tendon of tibialis posterior.
- **Insertion:** By 2 small tendons (medial & lateral) into the medial & lateral sides of the base of proximal phalanx of the big toe. Each tendon contains a sesamoid bone.
- **Nerve supply:** Medial plantar nerve.
- **Action:** Flexes the metatarso-phalangeal joint of the big toe.

2. Flexor digit minimi brevis:

- **Origin:** Base of 5th metatarsal bone.
- **Insertion:** Base of proximal phalanx of little toe.
- **Nerve supply:** Lateral plantar nerve.
- **Action:** Flexes the metatarso phalangeal joint of little toe.



3. Adductor hallucis:

- **Origin:** By 2 heads.
 1. **Oblique head:** from the **peroneus longus tendon** and from the bases of **2nd, 3rd & 4th (middle) metatarsals**.
 2. **Transverse head:** from the capsules & ligaments of the lateral 4 metatarso-phalangeal joints.
- **Insertion:** The 2 heads unite to be inserted into **lateral side of base of the proximal phalanx of the great toe**.
- **Nerve supply:** Lateral plantar nerve.
- **Action:**
 1. The oblique head **adducts the big toe**.
 2. The transverse head helps to **maintain the transverse arch of the foot** by drawing the roots of the toes closer.

Fourth Layer of the Sole

Contains:

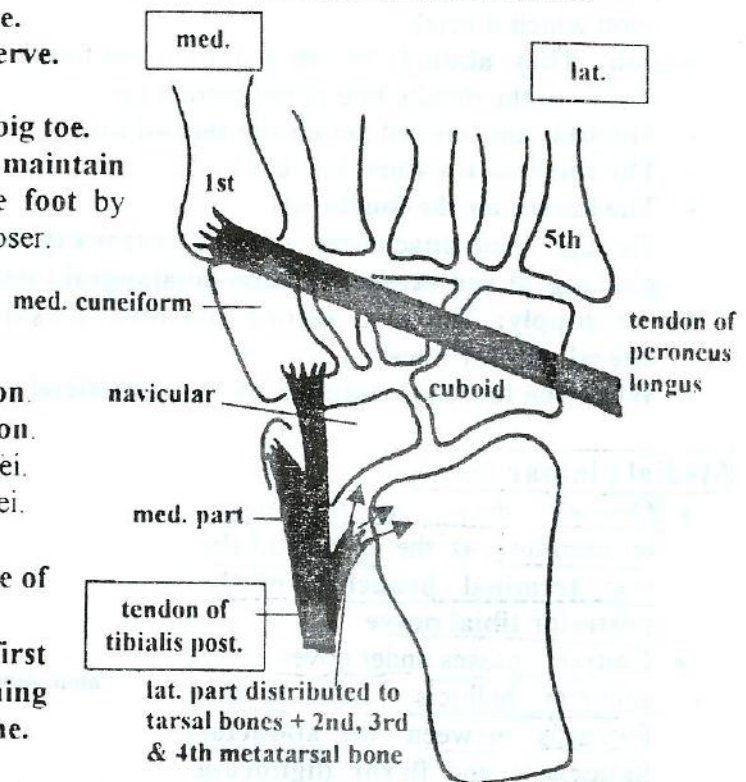
- A. 2 tendons: - **Peroneus longus tendon**
- **Tibialis posterior tendon**.
- B. 2 types of muscles: - **Plantar interossei**.
- **Dorsal interossei**.

Tendon of peroneus longus:

- Runs across the foot in the **groove of the cuboid bone**.
- Inserted into the **base of first metatarsal bone** and the **adjoining part of the medial cuneiform bone**.

Tendon of tibialis posterior:

- Its tendon divides into a **larger medial** and a **smaller lateral** parts.
- The **larger medial part** is inserted by slips mainly into the **tuberosity of navicular bone** and partly into the **medial cuneiform bone**.
- The **smaller lateral part** divides into many slips which are inserted into the **other tarsal bones except the talus** and the **bases of the second, third and fourth metatarsal bones**.



Plantar interossei:

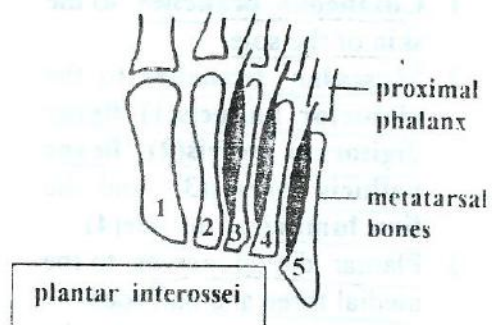
- **Three in number**.
- Origin:** Each arises from the **metatarsal bone of the digit upon which it acts**.
- The **first** acts on the **third toe**,
- The **second** on the **fourth toe** and
- The **third** on the **little toe**.

Insertion: Each is inserted partly into the **base of the proximal phalanx** and partly into the **extensor expansion**.

Action: They **adduct the lateral three toes** towards the middle line of the second toe.

- Through the **extensor expansions** they help in **flexion of the metatarso-phalangeal** and **extension of the inter-phalangeal joints**.

Nerve supply: The **first and second** are supplied by the **deep-branch**; while the **third** is supplied by the **superficial branch** of the **lateral plantar nerve**.



Dorsal interossei:

- Four in number.

Origin: Each arises from two adjacent metatarsal bones.

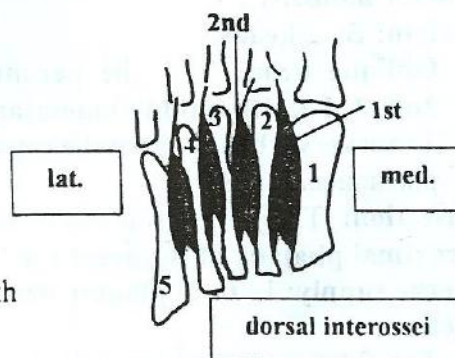
Insertion: Their insertion is like that of the plantar interossei (into the proximal phalanx and extensor expansion of the digit upon which it acts).

Action: They **abduct** the second, third and fourth toes from the middle line of the second toe.

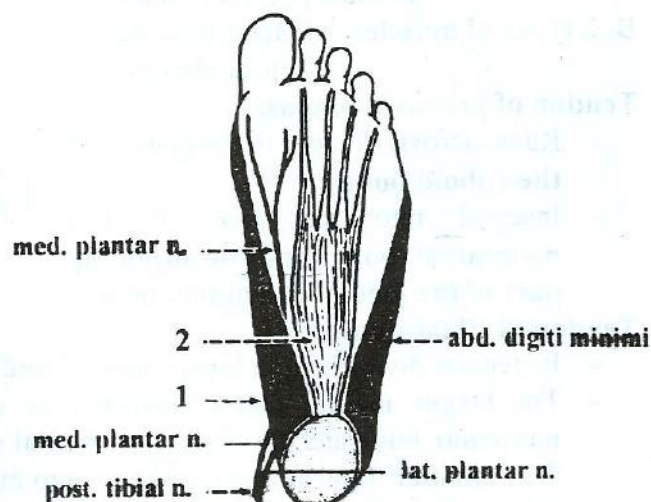
- The first and second act on the second toe;
- The third on the third toe; and
- The fourth on the fourth toe.
- Through their attachment to the extensor expansion they flex the metatarso-phalangeal and extend the inter-phalangeal joints.

Nerve supply: The first, second and third are supplied by the deep branch of lateral plantar nerve.

While the fourth is supplied by the superficial branch of the lateral plantar nerve.

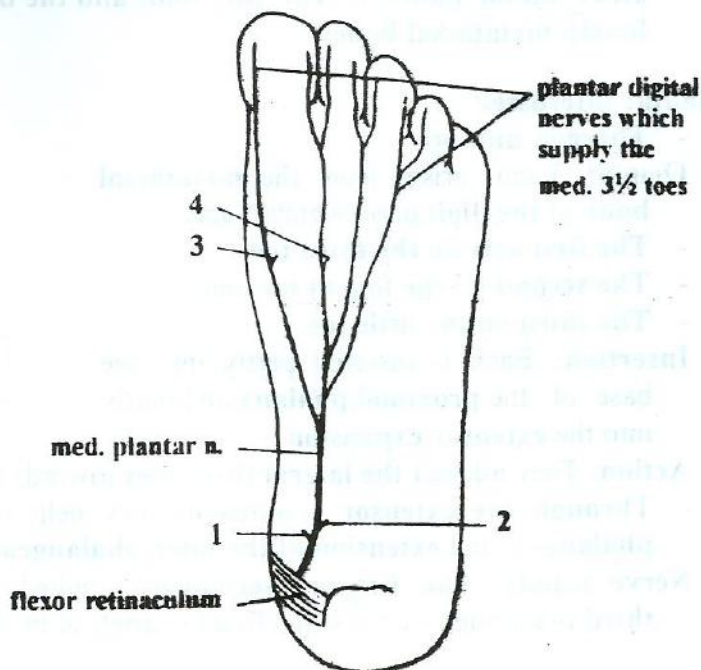
**Medial plantar nerve**

- **Origin:** deep to the flexor retinaculum as the larger of the two terminal branches of the posterior tibial nerve.
- **Course:** passes under cover of the abductor hallucis. Then, it runs forwards between the abductor hallucis(1) and flexor digitorum brevis(2), along the lateral side of the medial plantar vessels.



- **Branches:**

1. **Cutaneous branches** to the skin of the sole.
2. **Muscular branches** to the abductor hallucis(1), flexor digitorum brevis(2), flexor hallucis brevis(3) and the first lumbrical muscle(4).
3. **Plantar digital nerves** to the medial three and half toes.
4. **Articular branches** to the intertarsal and tarso-metatarsal joints.



Lateral plantar nerve

- **Origin:** deep to the flexor retinaculum, as the smaller of the two terminal branches of the posterior tibial nerve.
- **Course:** runs forwards and laterally between the flexor digitorum brevis (in the 1st layer) and flexor digitorum accessories (deep in the 2nd layer), along the medial side of the lateral plantar vessels. At the interval between the flexor digitorum brevis and abductor digiti minimi.

It terminates by dividing into two terminal branches: superficial and deep.

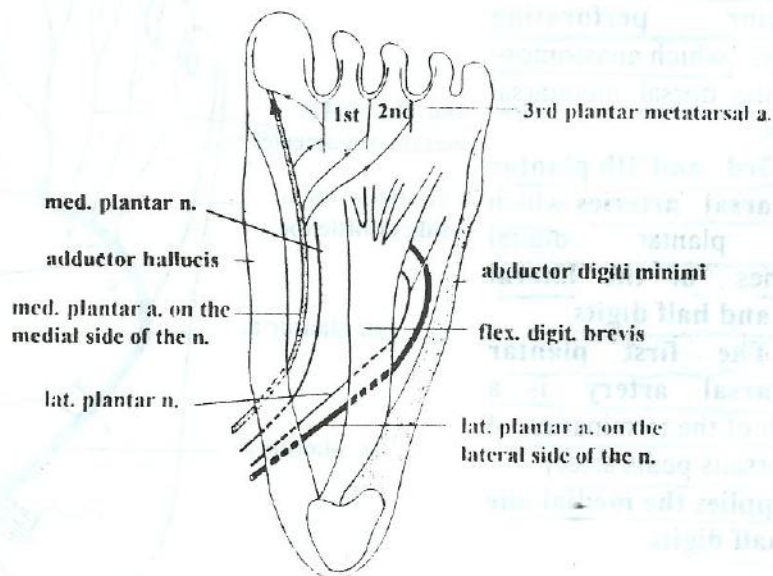
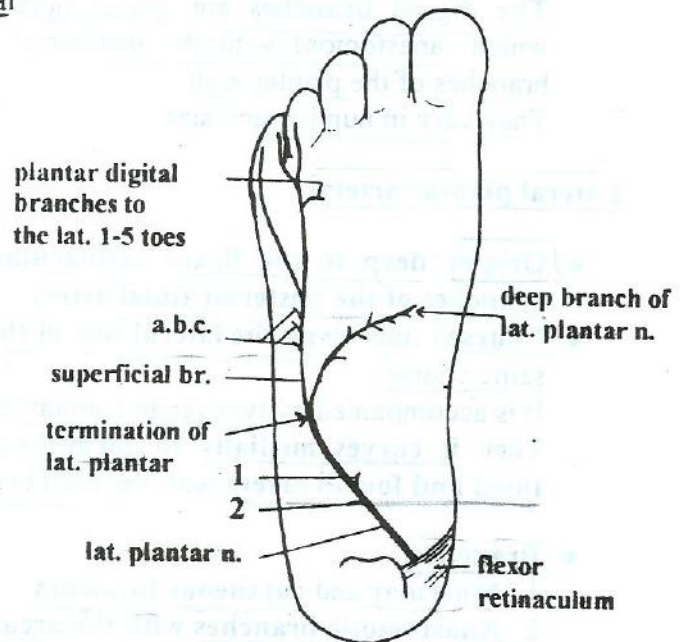
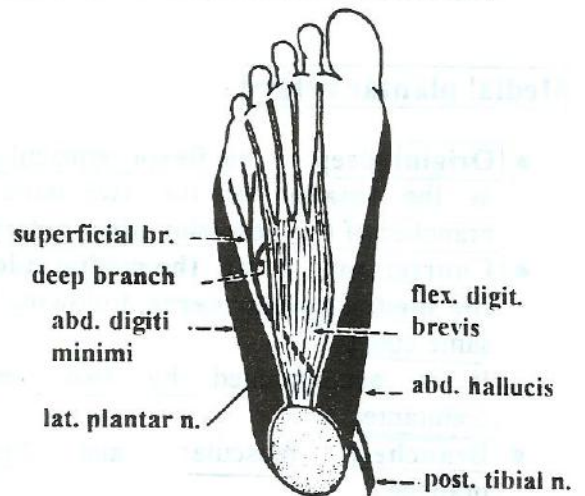
• **Branches:**

1. **From the trunk of the nerve:** muscular branches to the flexor abductor digiti minimi(1) and digitorum accessories(2) and cutaneous branches to the skin of the sole.
2. **Superficial branch:** supplies the flexor digiti minimi brevis(a), third plantar interosseous(b) and fourth dorsal interosseous(c). It gives plantar digital branches to the lateral one and half toes.

3. **Deep branches:** runs medially between the third and fourth layers behind the plantar arch.

It gives muscular branches to the adductor hallucis, second, third and fourth lumbricals, first and second plantar interossei and first, second and third dorsal interossei.

It also supplies the inter-tarsal and tarso-metatarsal joints.



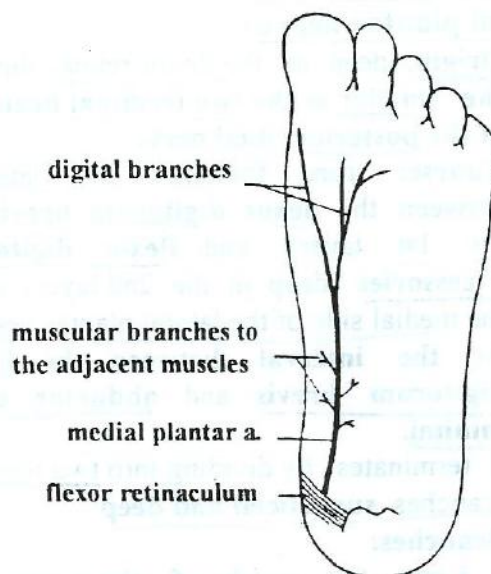
Medial plantar artery

- **Origin:** deep to the flexor retinaculum, as the smaller of the two terminal branches of the posterior tibial artery.
- **Course:** runs along the medial side of the medial plantar nerve, following the same course.
It is accompanied by two venae comitantes.

- **Branches:** muscular and digital branches.

The digital branches are one or more which anastomose with the metatarsal branches of the plantar arch.

They vary in number and size.



Lateral plantar artery

- **Origin:** deep to the flexor retinaculum, as the larger of the two terminal branches of the posterior tibial artery.
- **Course:** runs along the lateral side of the lateral plantar nerve, following the same course.

It is accompanied by two venae comitantes.

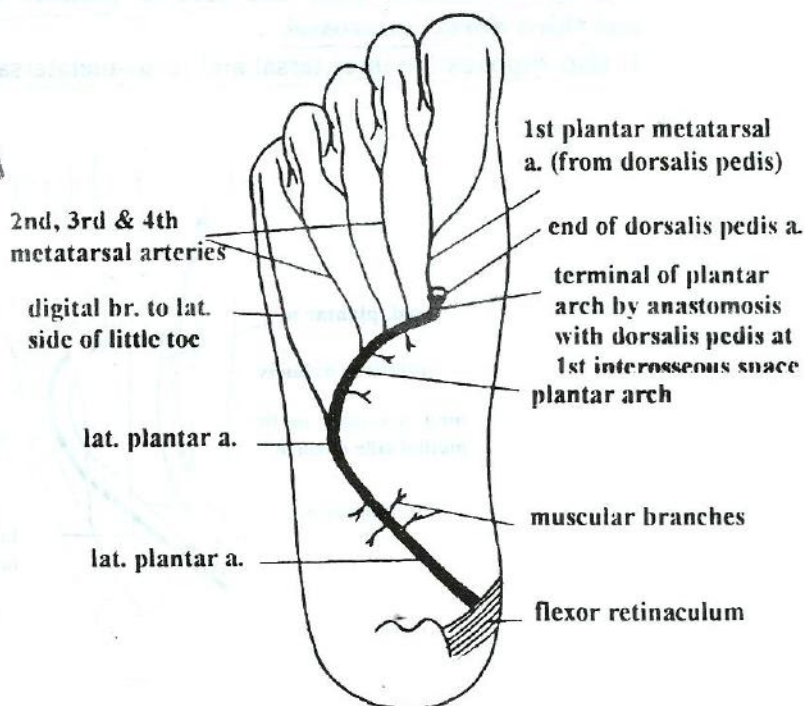
Then it curves medially to form the plantar arch which runs between the third and fourth layers with the deep branch of lateral plantar nerve.

- **Branches:**
 1. Muscular and cutaneous branches.
 2. Anastomotic branches with the arcuate artery on the dorsum of the foot.
 3. Plantar arch (the continuation of lateral plantar artery).

N.B.: The plantar arch gives:

1. Muscular branches.
2. Articular branches.
3. Posterior perforating arteries which anastomose with the dorsal metatarsal arteries.
4. 2nd, 3rd and 4th plantar metatarsal arteries which give plantar digital branches of the lateral three and half digits.

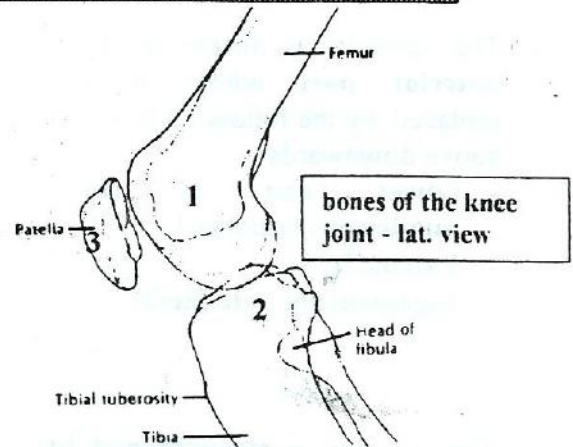
N.B.: The first plantar metatarsal artery is a branch of the termination of the dorsalis pedis artery.
It supplies the medial one and half digits.



KNEE JOINT

Type and articulating bones:

- It is a **synovial joint** of the **condylar variety (or modified hinge)**.
- It is a **modified hinge** because it also allows some medial and lateral rotation and not pure flexion and extension as in any classical hinge joint.
- The articulating bones are:
 - (1) Lower end of the femur.
 - (2) Upper end of the tibia.
 - (3) Posterior surface of the patella.



Some details about the articulations in the knee joint.

The knee joint is a **compound synovial joint** & has **2 articulations**:

1. **femuro-tibial**: between the 2 condyles of femur and those of tibia. It is synovial of condylar or modified hinge variety.
2. **femuro-patellar**. It is synovial of plane or gliding variety.

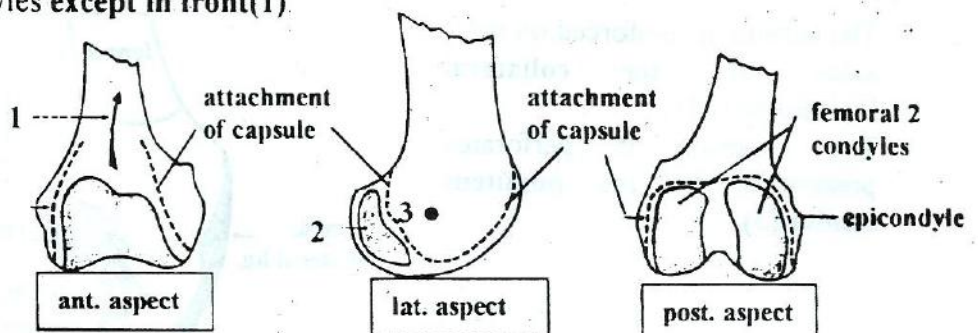


Fibrous capsule:

● Attachments:

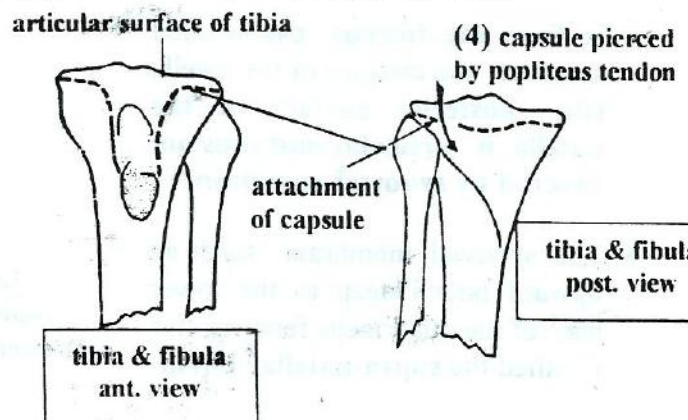
- **Above (proximally)**: The capsule is attached to the margins of the articular surface of the 2 femoral condyles **except in front(1)**.

attachment of the capsule to the margins of the femoral condyles except in front



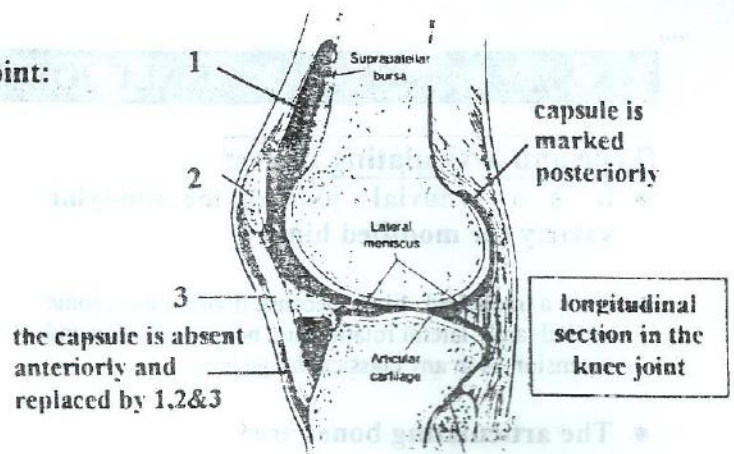
- **On the lateral aspect**, the capsule is attached just above the groove for popliteus(2), but just below the lateral epicondyle(3) (The medial and lateral epicondyles lie outside the capsule because they give attachment to the collateral ligaments).

- **Below (distally)**: The capsule is attached to the 2 tibial condyles immediately close to the articular surfaces.
- The capsule is pierced opposite the back of the lateral condyle by popliteus tendon(4).



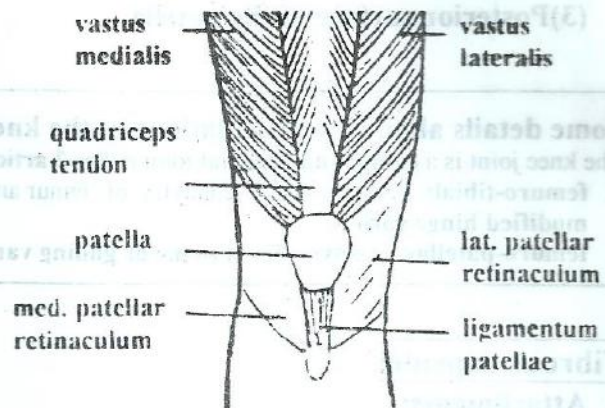
• Characteristics of the capsule of knee joint:

- The capsule is absent in its anterior part where it is replaced by the following (from above downwards):
 - Lower part of the quadriceps femoris(1).
 - Patella(2).
 - Ligamentum patellae(3).



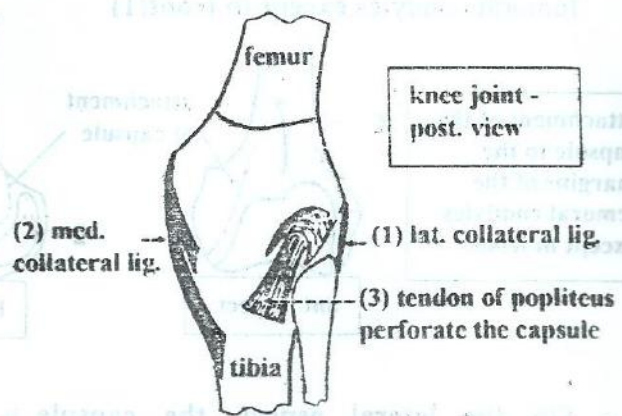
- The capsule is strengthened by expansions from the surrounding muscles, as follows:

- Laterally: from the vastus lateralis gives lateral patellar retinaculum.
- Medially: The vastus medialis gives medial patellar retinaculum.



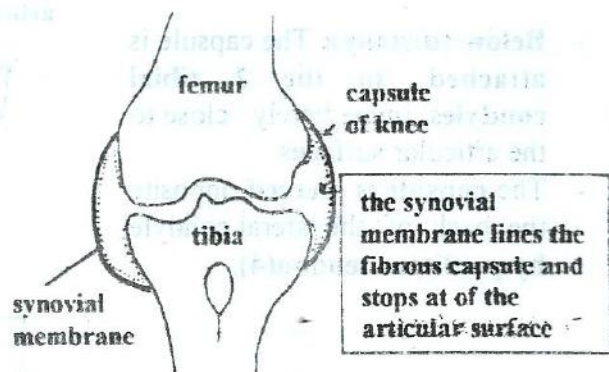
- The lateral and medial patellar retinacula fuse with the margins of the patella and ligamentum patellae.

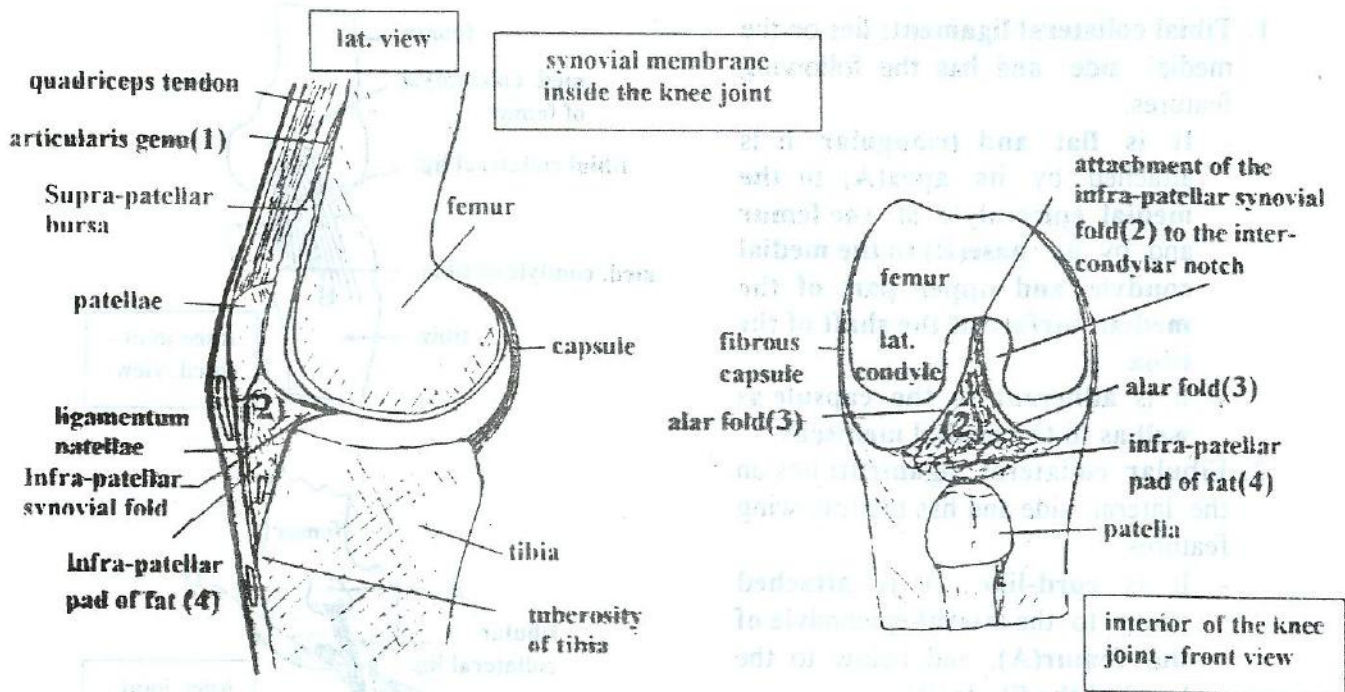
- The capsule is reinforced on the 2 sides by the collateral ligaments(1, 2).
- The capsule is perforated posteriorly by the popliteus tendon(3).



Synovial membrane:

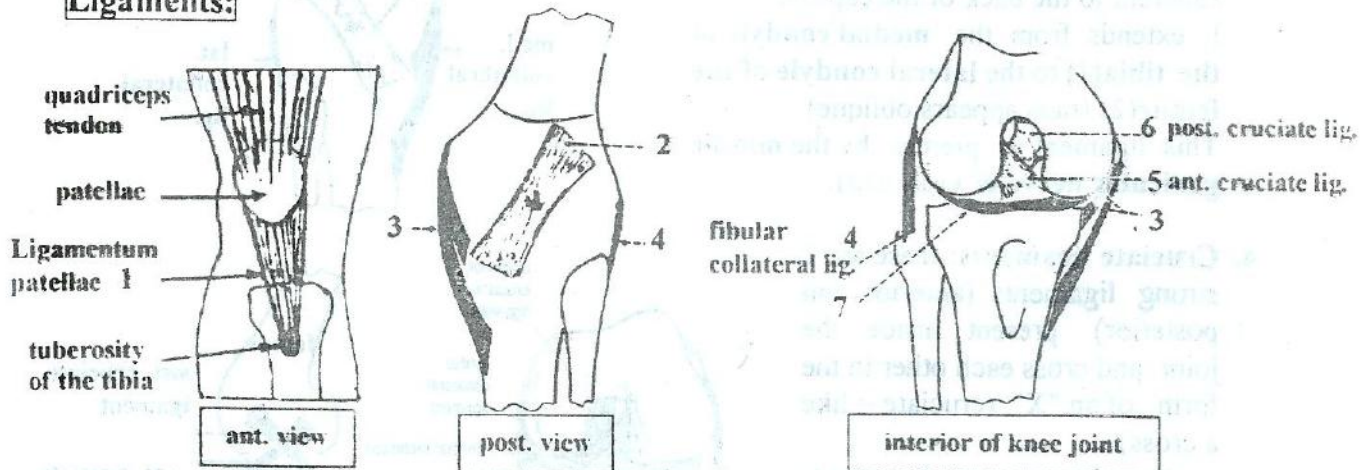
- It lines the fibrous capsule and stops at the margins of the patella (the posterior surface of the patella is articular and thus not covered by synovial membrane).
- The synovial membrane sends an upward pouch deep to the lower part of the quadriceps femoris; this is called the suprapatellar bursa.





- The synovial membrane of the supra-patellar bursa gives attachment to the articularis genu muscle(1).
- An infra-patellar synovial fold(2) extends backwards from the back of the ligamentum patellae to the front of the intercondylar notch of the femur. This fold is called the **infra-patellar fold** and its sides are prolonged laterally to form the **alar folds(3)**.
- Beneath the infra-patellar fold lies a large quantity of fat called the **infra-patellar pad of fat(4)**.
- The **tendon of popliteus** lies inside the joint (**intracapsular**) and is surrounded by a sheath of synovial membrane. It lies **extra-synovial**.

Ligaments:

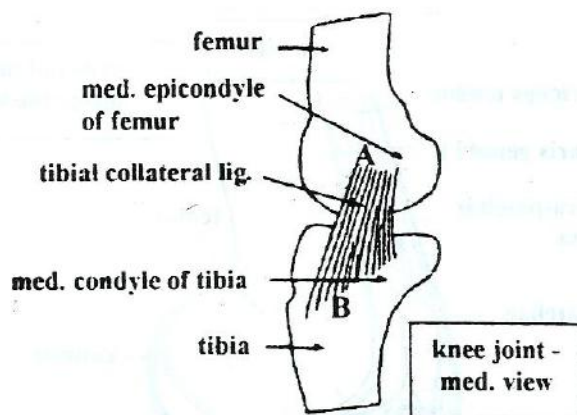


The ligaments of the knee are arranged as follows:

- **One in front:** ligamentum patellae(1).
- **One posterior:** oblique popliteal ligament(2).
- **One on each side:** tibial(3) and fibular(4) collateral ligaments.
- **Three inside:** 2 cruciate ligaments(5,6) and the transverse ligament of the knee(7).

1. Tibial collateral ligament: lies on the medial side and has the following features:

- It is **flat and triangular**. It is attached by its **apex(A)** to the **medial epicondyle of the femur** and by its **base(B)** to the **medial condyle and upper part of the medial surface of the shaft of the tibia**.
- It is **adherent to the capsule as well as to the medial meniscus**.

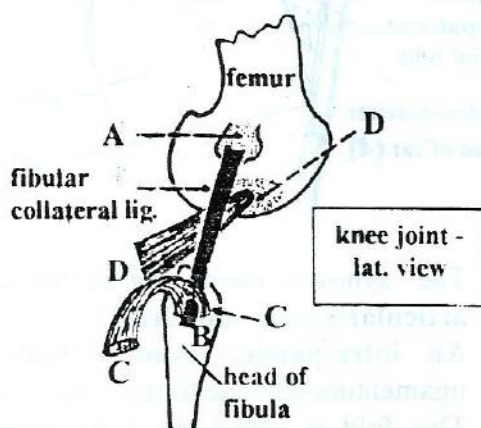


2. Fibular collateral ligament: lies on the lateral side and has the following features:

- It is **cord-like**. It is attached above to the **lateral epicondyle of the femur(A)**, and below to the **head of the fibula(B)**.
- It is related to **2 tendons**: the **biceps femoris(C)** (superficial) and the **popliteus tendon(D)** (deep).

The popliteus tendon separates the ligament from the lateral meniscus.

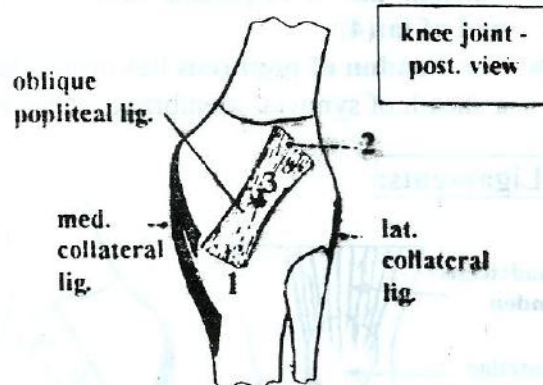
- It is **not adherent** to either the fibrous capsule or the lateral meniscus.



3. Oblique popliteal ligament: is closely adherent to the back of the capsule.

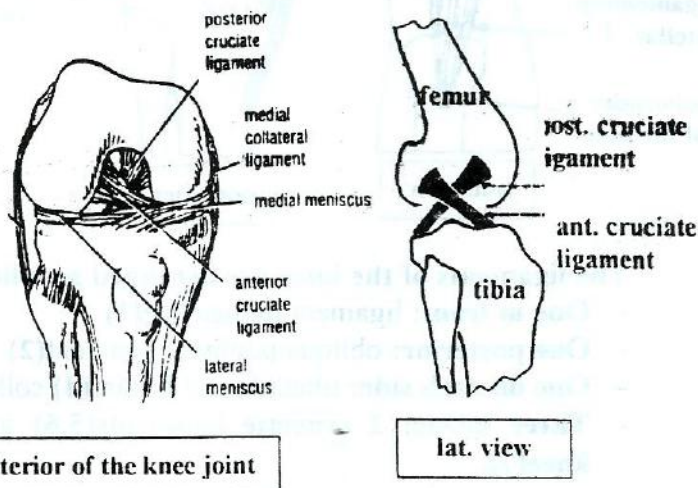
It extends from the **medial condyle of the tibia(1)** to the **lateral condyle of the femur(2)** (thus appears oblique).

This ligament is pierced by the **middle genicular nerve & vessels(3)**.



4. Cruciate ligaments: these are 2 strong ligaments (anterior and posterior) present inside the joint and cross each other in the form of an "X", (cruciate = like a cross).

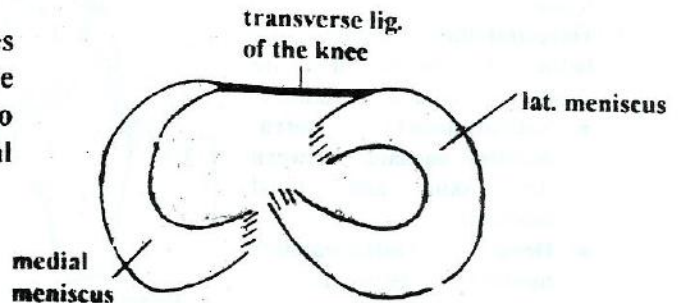
a. Anterior cruciate ligament: extends from the **anterior part of the intercondylar area of the tibia** to the **posterior part of the inner surface of the lateral condyle of femur**.



- b. **Posterior cruciate ligament:** extends from the posterior part of the intercondylar area of the tibia to the anterior part of the inner surface of the medial condyle of femur.

Note that the anterior cruciate is tightly stretched in extension while the posterior cruciate is tightly stretched in flexion.

5. **Transverse ligament of the knee:** lies inside the joint, and extends from the anterior horn of the medial meniscus to the anterior margin of the lateral meniscus.



Structures inside the knee joint:



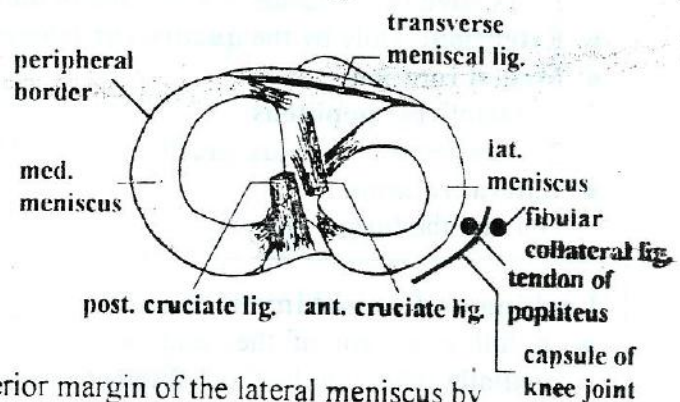
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|--|-------------------------------|
| 1. The 2 menisci. | 2. The 2 cruciate ligaments. |
| 3. Transverse ligament of the knee. | 4. Tendon of popliteus. |
| 5. Infra-patellar fold (of synovial membrane). | 6. Infra-patellar pad of fat. |

Menisci (semilunar cartilages):

- These are 2 curved plates of fibro-cartilage (medial and lateral) attached by their horns to the intercondylar area of the tibia.
- The **peripheral** border of each meniscus is **thick**, while its **inner** border is **thin**.
- They **deepen** the surfaces on which the condyles of the femur play and as-a result the articulating femoral and tibial condyles become more fitting.

1. Medial meniscus:

- It is **semicircular** in form and its horns are widely separated (looks like the letter "C"). Its 2 horns are attached to the intercondylar area of the tibia.
- Its **peripheral border** is attached to the **capsule** of the knee through which it is firmly adherent to the tibial collateral ligament.
- Its anterior horn is connected with the anterior margin of the lateral meniscus by the transverse ligament of the knee (**transverse meniscal ligament**).
- Its **more fixed and more liable to be turned** than the lateral meniscus.

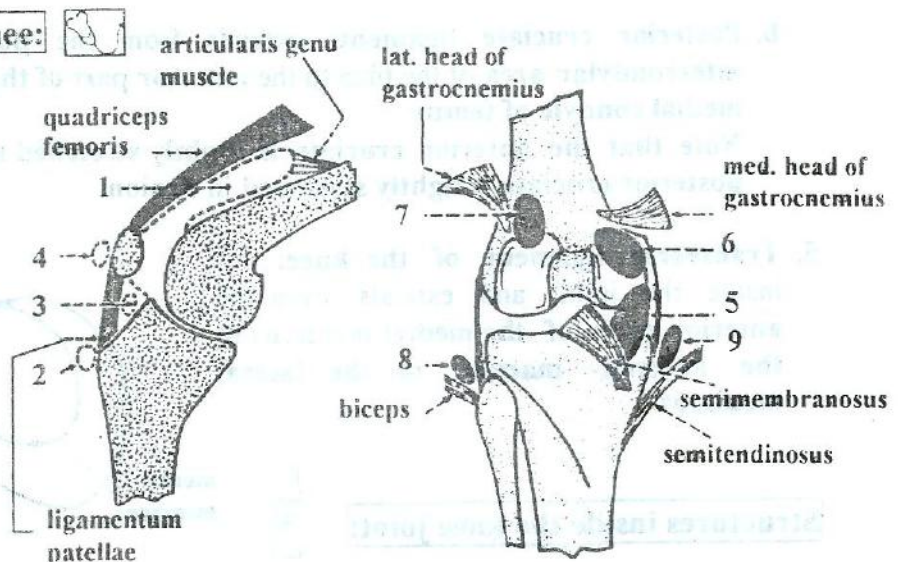


2. Lateral meniscus:

- It is **nearly circular** in form and its horns are attached close to each other (looks like the letter "O").
- It is **not adherent** to the capsule of the knee joint and to the fibular collateral ligament because it is **separated from the capsule by the tendon of popliteus**.
- The tendon of popliteus is attached to the lateral meniscus, and as a result **this meniscus moves with the contraction of this muscle**.
- It is **more mobile** than the medial meniscus, being **not adherent to the capsule & fibular collateral ligament** and being attached to the tendon of the popliteus. Accordingly, it is **less exposed to injury** than the medial meniscus which is more fixed.

Main bursae around the knee:

1. **Supra-patellar bursa(1):** lies between the lower part of the quadriceps femoris and the lower part of the front of femur.
2. **Infra-patellar bursae:** lie below the patella. These are superficial and deep as follows:
 - **Subcutaneous infra-patellar bursa(2):** between the skin and tibial tuberosity.
 - **Deep infra-patellar bursa(3):** between the ligamentum patellae and the upper end of the tibia.
3. **Pre-patellar bursa(4):** in front of the patella.
4. **Semimembranosus bursa(5):** lies between the insertion of the semimembranosus muscle and back of the knee joint.
5. **A bursa deep to the medial(6) and lateral head of gastrocnemius(7).**
6. **Bursa between the lateral ligament(8) and biceps tendon.**
7. **Bursa between the insertion of sartorius gracilis(9) and semitendinosus.**

**Movements and acting muscles:**

- **Flexion:**
 1. Mainly by: **hamstring muscles** (biceps femoris, semitendinosus and semimembranosus) and **gastrocnemius muscle**.
 2. Assisted by: sartorius, gracilis and popliteus.
- **Extension:** Only by the **quadriceps femoris**.
- **Medial rotation:**
 1. Mainly by: **popliteus**.
 2. Assisted by: sartorius, gracilis and semitendinosus.
- **Lateral rotation:** Only by the **biceps femoris**.

Locking and unlocking of the knee:

- In full extension of the joint, with the foot on the ground the **femur rotates medially** (but with the foot off the ground the **tibia rotates laterally**).
- This rotation occurs at the end of full extension, and "**locks the joint**" which means that the joint cannot be flexed unless it is unlocked by reversing the rotation which has taken place.
- **At the beginning of flexion** the joint is "**unlocked**" by the action of **popliteus** which produces lateral rotation of the femur (or medial rotation of the tibia).
- In full extension with the knee locked, **all its ligaments** are tightly stretched and the joint becomes very stable.

Nerve supply of the knee joint: it receive branches form:

1. Femoral nerve.
2. Obturator nerve.
3. Tibial nerve.
4. Common peroneal nerve.

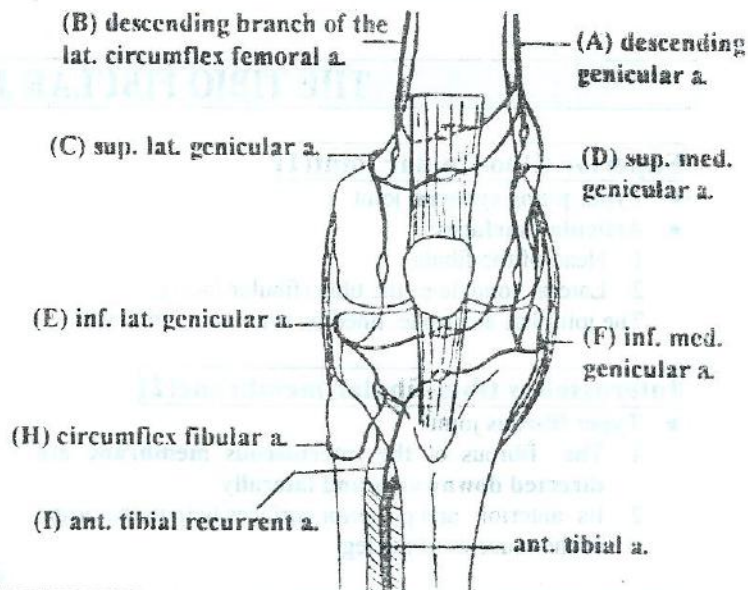
Arterial supply of the knee joint:

It receive blood from the **anastomosis around the knee**, specially the genicular branches of popliteal artery.

Anastomosis around the knee

It is formed by 10 branches:

1. **Descending genicular (A)** (branch of femoral artery).
2. **Descending branch of lateral circumflex femoral (B)** (from profunda femoris artery).
3. **5 genicular branches (C,D,E,F,G)** (from popliteal artery)
4. **Circumflex fibular (H)** (branch of posterior tibial artery).
5. **Anterior tibial recurrent (I)** (branch of anterior tibial artery).
6. **Posterior tibial recurrent (J)** (branch of posterior tibial artery)



Remember that about the knee joint:

Type: synovial joint of modified hinge variety.

The capsule is absent anteriorly and replaced by quadriceps tendon, patella, ligamentum patellae.

Possible movement:

Extension: by quadriceps femoris muscle

Flexion: by hamstring muscles and gastrocnemius muscle.

Slight lateral rotation: by biceps femoris muscle.

Slight medial rotation: by popliteus muscle.

Supporting ligaments:

Anteriorly: ligamentum patellae.

Posteriorly: oblique popliteal ligament.

Laterally: fibular collateral ligament - related to 2 tendons (a. biceps tendon superficial & b. popliteus tendon deep). The popliteus tendon separates the tibial collateral ligament from lateral meniscus.

Medially: tibial collateral ligament & firmly adherent to the capsule & medial meniscus.

Ligaments inside the joint capsule:

Anterior cruciate ligament tightly stretched in extension &

Posterior cruciate ligament tightly stretched in flexion and

Transverse ligament of the knee which extends between the anterior horns of the 2 menisci.

Other important structure inside the capsule: (the 2 menisci + tendon of popliteus).

Medial meniscus:

C shaped, Medially, it is attached to the inter-condylar area.

laterally, it is attached to the capsule.

It is more fixed and liable to be injured.

The lateral meniscus:

O shaped, medially, it is attached to the inter-condylar area.

Laterally, it is not attached to capsule of the knee joint.

It is separated from the capsule by the tendon of popliteus muscles.

It is more mobile & less liable to be injured

Tendon of popliteus:

It is intra-capsular but extra-synovial.

It separates the fibular collateral ligament from the lateral meniscus.

THE TIBIO FIBULAR JOINTS

Superior tibio-fibular joint(1)

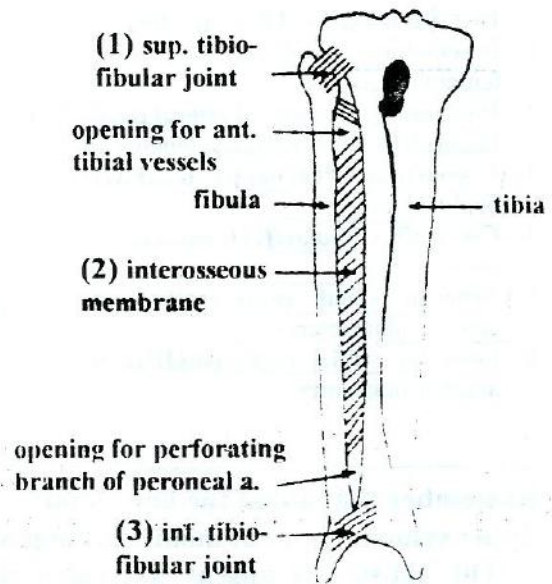
- **Type:** plane synovial joint.
- **Articular surfaces:**
 1. Head of the fibula.
 2. Lateral condyle of the tibia (fibular facet).
- The joint has a capsule, lined by synovial membrane.

Interosseous tibio-fibular membrane(2)

- **Type:** fibrous joint.
- 1. The fibrous of the interosseous membrane are directed downwards and laterally.
- 2. Its anterior and posterior surfaces help to the origin of the muscles of the leg

Inferior tibio - fibular joint(3)

- **Type:** fibrous joint.
- **Articular surfaces:**
 1. Rough medial side of the lower end of the fibula.
 2. Fibula notch of the tibia
- **Ligaments:** the 2 bones are connected by interosseous, anterior and posterior inferior tibio-fibular ligaments.



ANKLE JOINT

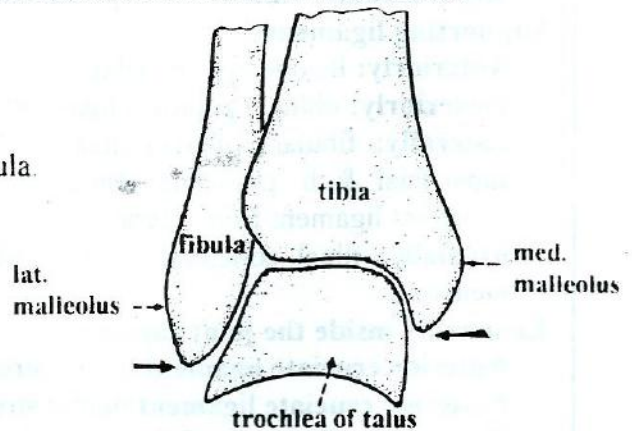
Type and articulating bones:

- It is a synovial joint of the hinge variety.
- It is formed by:

Above: the lower ends of both the tibia and fibula.

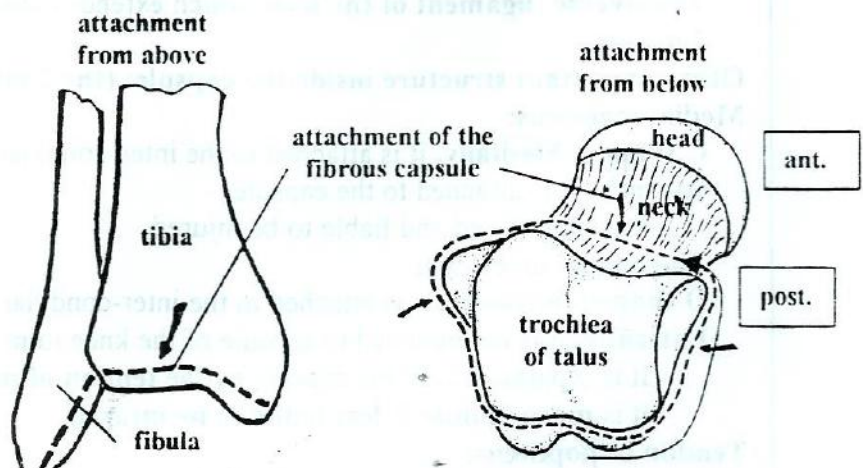
Below: by the trochlea of the talus.

- The trochlea of the talus lies in a deep socket formed by the medial and lateral malleoli as well as by the transverse tibiofibular ligament which forms the posterior part of the socket.



Fibrous capsule:

- **Attachments:**
 - **Above:** The line of attachment of the fibrous capsule is very close to the articular surfaces of the lower ends of the tibia and fibula.
 - **Below:** it is attached close to the trochlear surface of the talus except in front where a part of the dorsum of the neck of talus is intracapsular.



note that the post. part of the neck is intracapsular

• Characteristics:

- The capsule is thin anteriorly and posteriorly.
- It is strengthened on each side by a strong collateral ligament.

Synovial membrane:

It lines the fibrous capsule and is reflected on to the dorsal surface of the neck of the talus which is intracapsular.

It ascends for a short distance between the tibia and fibula.

Ligaments:

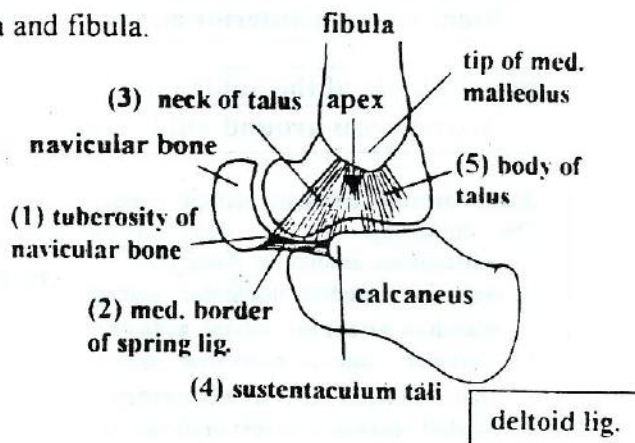
There are 2 strong collateral ligaments (one on each side):

1. Medial ligament (deltoid ligament):

It is triangular in shape (hence the name deltoid).

It is attached by:

- Its apex (above) is attached to the tip of the medial malleolus, and by
- Its base (below) is attached to the tuberosity of navicular bone(1), spring ligament(2), neck of talus(3), sustentaculum tali(4) and body of talus(5) (as arranged from before backwards).



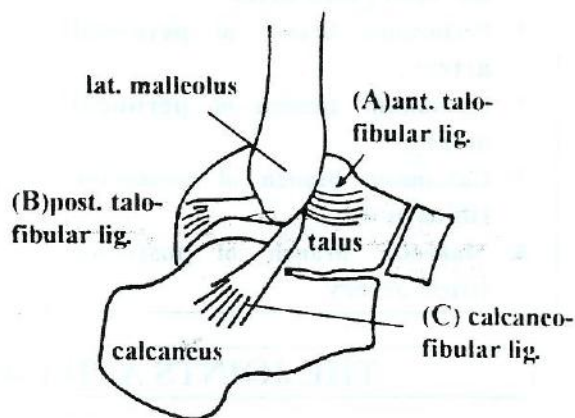
2. Lateral ligament:

It is composed of 3 separate bands radiating from the tip of the lateral malleolus to the talus and calcaneus as follows:

(A) **Anterior band:** is horizontal and extends forwards to the side of the talus (**anterior talo-fibular**).

(B) **Posterior band:** is also horizontal and extends backwards to the lateral tubercle of the talus (**posterior talo-fibular**).

(C) **Middle band:** is more vertical and extends downwards and backwards to the side of the calcaneus (**calcaneo-fibular**). It is cord-like (**Remember that the fibular collateral ligament of the knee is also cord-like**).



Movements:

As any hinge joint, the movements are **flexion and extension** that take place around one axis only (**uni-axial**). It is generally agreed to name extension and flexion of the ankle as **dorsi flexion** and **plantar flexion** respectively although the respective muscles are named extensors and flexors.

1. Dorsi flexion: means moving the foot upwards, and is produced by (the muscles of the anterior compartment of the leg):

- Extensor digitorum longus.
- Extensor hallucis longus.
- Tibialis anterior.
- Peroneus tertius.

2. Plantar flexion: means moving the foot downwards, and is produced by (the superficial and deep muscles of the posterior compartment of the leg):

- Soleus, gastrocnemius and plantaris (main).
- Flexor digitorum longus.
- Flexor hallucis longus.
- Tibialis posterior.

Relations of the ankle joint

Anteriorly: structures deep to the superior extensor retinaculum (page 82).

Posteriorly: structures deep to the flexor retinaculum (page 94).

Laterally: structures deep to peroneal retinaculum (page 84).

Nerve supply of the ankle joint

Branches from **anterior** and **posterior** tibial nerves.

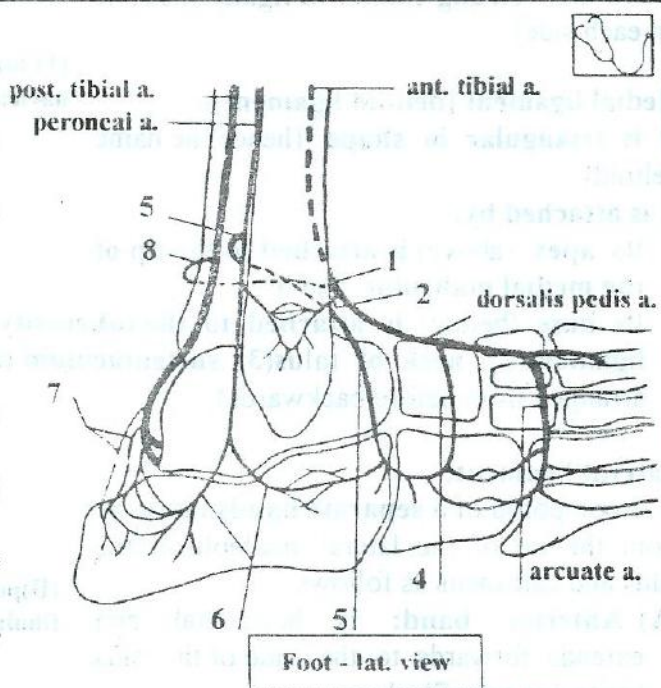
Blood supply of the ankle joint

Anastomosis around ankle joint.

Anastomosis around ankle joint

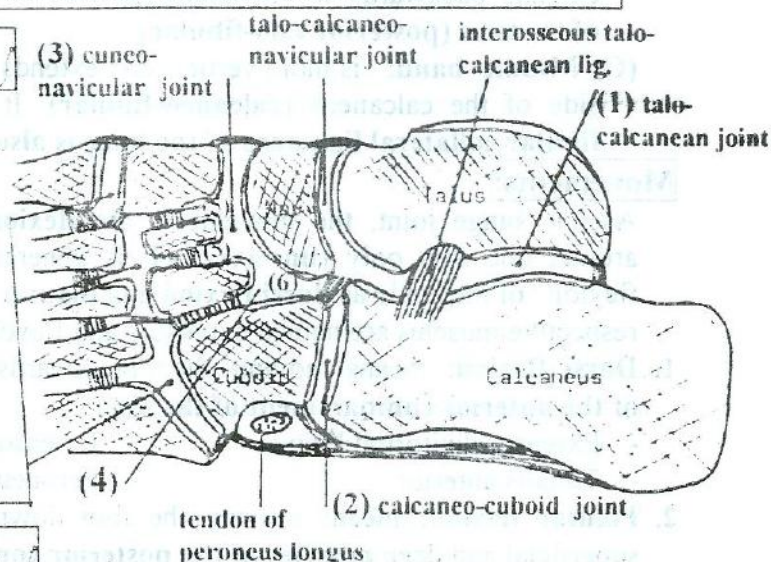
The following arteries share in the anastomosis around the ankle joint:

1. **Anterior medial malleolar artery:** branch of **anterior tibial artery**.
2. **Anterior lateral malleolar artery:** branch of **anterior tibial artery**.
3. **Medial tarsal arteries:** branches of **dorsalis pedis artery**.
4. **Lateral tarsal artery:** branch of **dorsalis pedis artery**.
5. **Perforating branch of peroneal artery.**
6. **Calcaneal branch of peroneal artery.**
7. **Calcaneal branch of posterior tibial artery.**
8. **Malleolar branch of posterior tibial artery.**

**THE JOINTS AND LIGAMENTS OF THE FOOT****A. Tarsal joints and ligaments****1. Talo-calcaneal (subtalar) joints:**

- It is a plane synovial joint between talus and calcaneus.
- The joint has an articular capsule and interosseous talo-calcaneal ligament.

tarso-metatarsal joints

**2. Calcaneo-cuboid joint:**

- It is a plane synovial joint.

3. Cuneo-navicular, 4. Cuneo-cuboid, 5. Inter-cuneiform, and 6. Cubo-navicular joints: all are plane synovial joints.

Talo-calcaneo-navicular joint

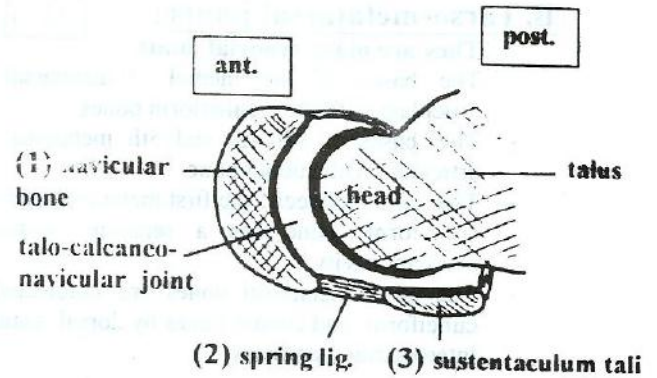
- It is a synovial joint resembles ball and socket.

The ball is the head of talus, while

The socket is formed by:

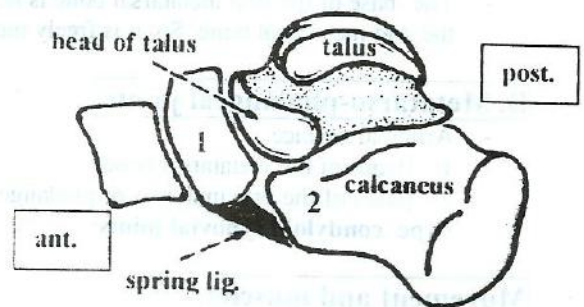
1. The navicular bone and
2. Upper surface of the spring ligament.
3. Sustentaculum tali (it is a part of calcaneus bone) and anterior part of superior surface of calcaneus.

- The joint has a capsule lined by synovial membrane.
- **Eversion and inversion** of the foot are the two movements that occur in the talo-calcaneo-navicular joint.



Plantar calcaneo-navicular (spring) ligament:

- It is a strong and triangle ligament extends from navicular bone(1) to sustentaculum tali(2)
- Its anterior edge is attached to the plantar surface of the navicular bone(1).
- Its posterior border is attached to the anterior margin of the sustentaculum tali(2) of the calcaneus.
- Its medial margin (base) is attached to the deltoid ligament.

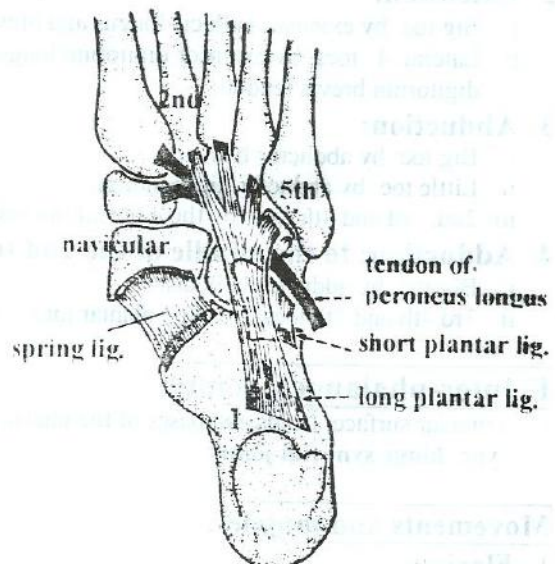


Short plantar ligament (plantar calcaneo-cuboid):

- It connects the plantar surfaces of the calcaneum(1) and cuboid bones(2)
- It lies deep to the long plantar ligament.

Long plantar ligament:

- It is attached to the plantar surface of the calcaneum(1) and cuboid(2) bones
- It bridges over the groove in the cuboid bones and changed it into a canal for the peroneus longus tendon.
- It sends 3 slips to be connected to the bases of the 2nd, 3rd and 4th metatarsal bones.



Movements in tarsal joints

1. **Gliding:** under the effect of body weight.
2. **Inversion and eversion** of the foot.

B. Tarso-metatarsal joints:

- They are plane synovial joints.
- The bases of the medial 3 metatarsal bones articulate with the 3 cuneiform bones.
- The bases of the 4th and 5th metatarsal bones articulate with cuboid bone.
- The joint between the first metatarsal and medial cuneiform bone has a separate capsule and synovial cavity.
- The other metatarsal bones are connected to the cuneiform and cuboid bones by dorsal, plantar and interosseous ligaments.

C. Inter-metatarsal joints:

- They are plane synovial joints.
- The bases of the lateral 4 metatarsal bones are connected together by dorsal, plantar and interosseous ligament.
- The base of the first metatarsal bone is not connected to the 2nd metatarsal bone. So, it is freely mobile.

D. Metatarso-phalangeal joints:

- Articular surface:
 1. Heads of the metatarsal bones.
 2. Bases of the proximal row of phalanges.
- Type: condyloid synovial joints:

Movement and muscles:**1. Flexion:**

- i. Big toe: by flexor hallucis longus and brevis.
- ii. Lateral 4 toes: by flexor digitorum brevis, lumbricals and interossei. These muscles are helped by flexor digitorum longus and in the little toe by flexor digiti minimi brevis also.

2. Extension:

- i. Big toe: by extensor hallucis longus and brevis.
- ii. Lateral 4 toes: by extensor digitorum longus and brevis (except little toe which has no extensor digitorum brevis tendon).

3. Abduction:

- i. Big toe: by abductor hallucis.
- ii. Little toe: by abductor digiti minimi.
- iii. 2nd, 3rd and 4th toes: by the 4 dorsal interossei.

4. Adduction: to the middle of the 2nd toe (axis)

- i. Big toe: by adductor hallucis.
- ii. 3rd, 4th and 5th toes: by the 3 plantar interossei.

E. Inter-phalangeal joints:

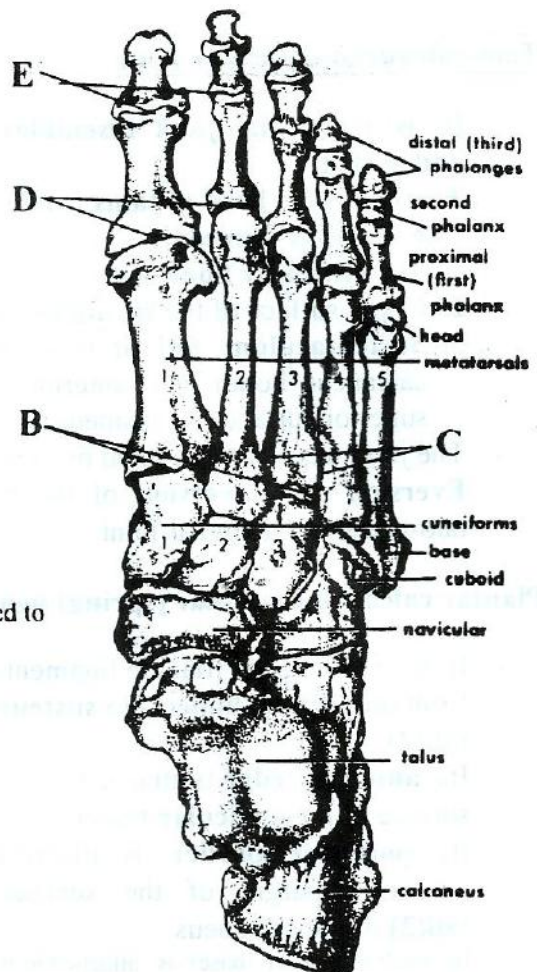
- Articular surface: heads and bases of the phalanges.
- Type: hinge synovial joints.

Movements and muscles:**1. Flexion:**

- i. Big toe: by flexor hallucis longus.
- ii. Lateral 4 toes:
 - a. Proximal inter-phalangeal joints: by flexor digitorum brevis helped by flexor digitorum longus.
 - b. Distal (terminal) inter-phalangeal joints: by flexor digitorum longus.

2. Extension:

- i. Big toe: by extensor hallucis longus.
- ii. Lateral 4 toes: by extensor digitorum longus and longus, helped by lumbricals and interossei.



TRANSMISSION OF THE BODY WEIGHT

- The body weight is transmitted from the **vertebral column(1)** to the **sacro-iliac joints(2)** and then down to the **hip joints**.
- From the hip joint the body weight is transmitted through the **head of femur(3)** to the **2 femoral condyles(4)** (especially the lateral) and then through the **tibia(5)** to the **talus(6)** the fibula does not share).
- In the foot, the body weight is distributed to all bones of the foot where **1/2 of the weight** is carried by the **calcaneus(7)** (thus of large size) and the **other 1/2** is carried by the **metatarsal bones(8)**.



- The points in the foot which bear the body weight are:
 1. Tuberosity of the calcaneus.
 2. Lateral border of the foot.
 3. Heads of all metatarsal especially the 1st metatarsal, which is the thickest.

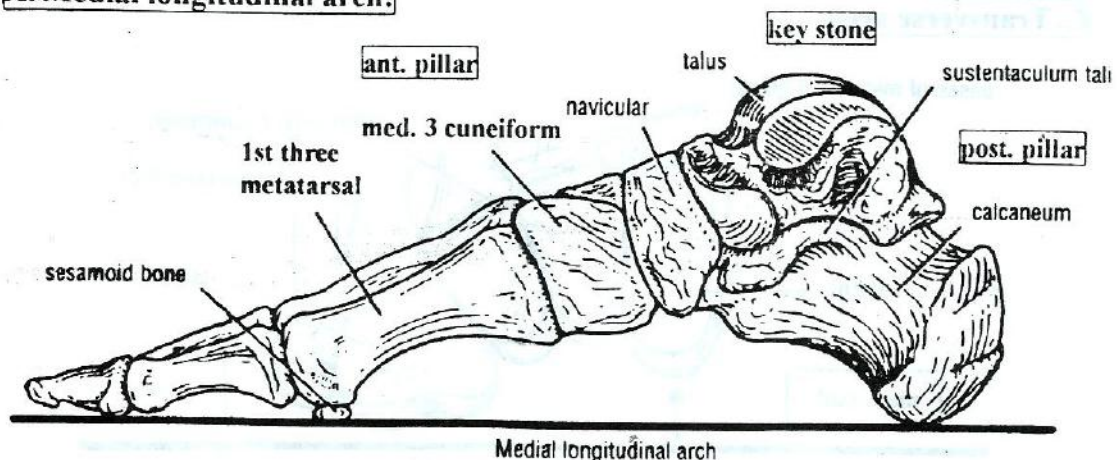


Arches of the foot



Longitudinal arches: divided into medial and lateral arches.

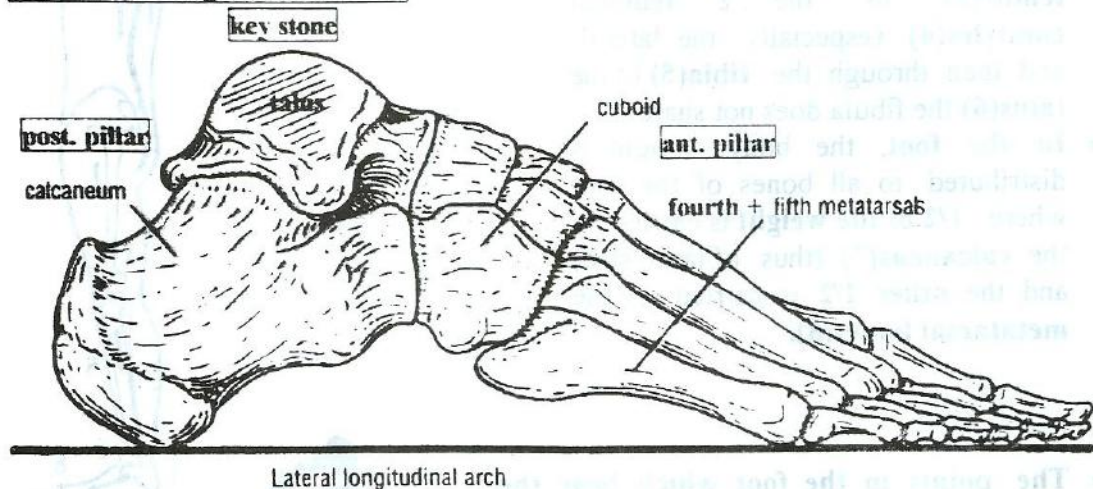
A. Medial longitudinal arch:



- Its **posterior pillar** is formed by the calcaneus.
- The **key stone** is formed by the **talus**.
- The **anterior pillar** is formed by the navicular, the three cuneiform and the first three metatarsal bones.

Factors maintaining the medial longitudinal arch:

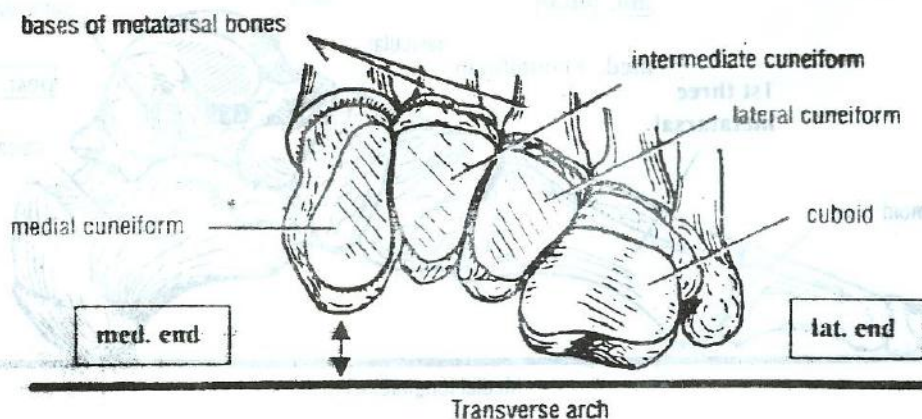
- i. **Muscles:** tendon of **tibialis posterior**, flexor hallucis longus, flexor digitorum longus, flexor digitorum brevis, and tibialis anterior.
- ii. **Ligaments:**
 - a. **Spring ligament** and **deltoid ligament**.
 - b. **Interosseous ligaments**.
 - c. **Plantar aponeurosis**.

B. Lateral longitudinal arch:

- The **key stone** is formed by **talus**.
- Its **posterior pillar** is also formed by the calcaneus.
- The **anterior pillar** is formed by the cuboid and the fourth and fifth metatarsal bones.

Factors maintaining the lateral longitudinal arch:

- i. **Muscles:** tendon of **flexor digitorum longus** and **brevis**.
- ii. **Ligaments:**
 - a. **Short plantar** (plantar calcaneo-cuboid) **ligament**.
 - b. **Long plantar ligament**.

C. Transverse arch:

- Formed mainly by the bases of the metatarsal bones and the distal row of tarsal bones (**cuboid + 3 cuneiform**).
- This arch is **Incomplete** i.e., its medial end does not reach the ground.

Factors maintaining the transverse arch:

- i. **Muscles:** tendon of **peroneus longus**.
- ii. **Ligaments:** **interosseous ligaments**.
- iii. **Bony factor:** the articulated bones of foot take the shape of transverse arch, (this is because the wedge shape of cuneiform bones, having wide surface dorsally, and narrow surface ventrally).

Function of the arches of the foot:

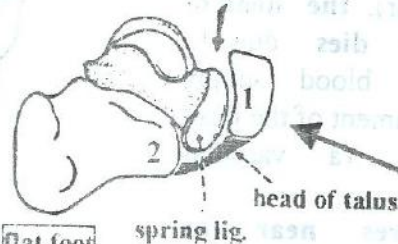
1. They provide space in the sole of the foot to contain and protect the muscles, nerves and blood vessels of the sole.
2. They provide elasticity to the foot.
3. They allow walking and running without pain.
4. The arches distribute the body weight 6 points or more.

Flat foot

- In flat foot the medial longitudinal arch is depressed.
- The head of the talus descends downwards and medial to separate between the navicular(1) and calcaneus(2) bones.
- It occurs after fatigue or disease of the muscles of the leg and foot e.g. after long standing, long walking, overweight or illness. As a result, the weak muscles and ligaments are stretched and pain is produced after walking or standing for a short distance.

normal foot

The navicular(1) and calcaneus(2) are not widely separated

normal foot**flat foot**

The navicular(1) and calcaneus(2) are widely separated

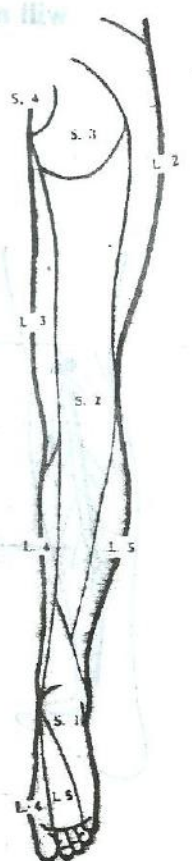
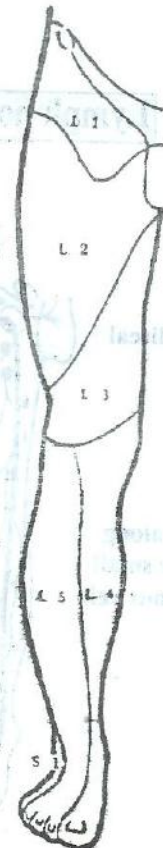
SEGMENTAL CUTANEOUS INNERVATION

The skin of the lower limb is supplied by the spinal cord segments from thoracic 12 to sacral 3.

This segmental distribution of nerves means that each spinal nerve supplied a specific segment of skin of the lower limb: this segment of skin is also called a dermatome.

The arrangement of the cutaneous supply of the lower limb is as follows:

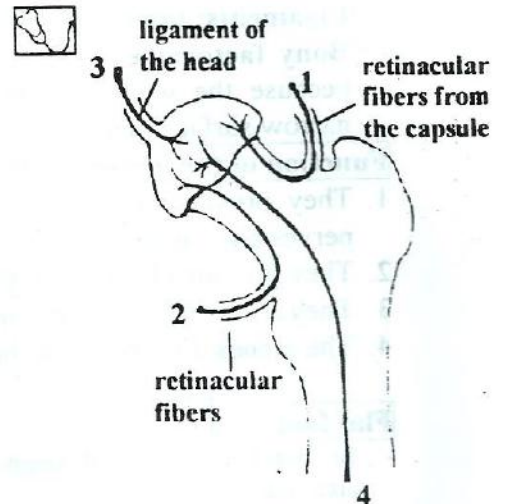
- a. The upper and lateral part of the gluteal region is supplied by the segments: thoracic 12 and lumbar 1 & 2.
- b. The front, medial and lateral aspects of the thigh are supplied by the segments: lumbar 1, 2 & 3.
- c. The medial part of the front and the medial side of the leg and the medial border of the foot are supplied by the segments: lumbar 4.
- d. The lateral part of the front and the lateral side of the leg and the intermediate part of the dorsum of the foot are supplied by the segment: lumbar 5.
- e. The lateral border of the foot is supplied by the segment: sacral 1.
- f. The medial part of the sole is supplied by the segment: lumbar 4, the intermediate part by: lumbar 5, and the lateral part by: sacral 1.
- g. The back of the leg and thigh are supplied by the segment: sacral 2.
- h. The inferior and medial part of the gluteal region is supplied by the segment: sacral 3 & 4.



SOME TOPICS IN APPLIED ANATOMY

Blood supply of the head of femur: from 4 arteries:

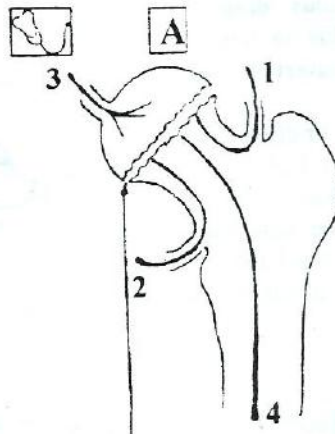
- (1) Branch from medial circumflex femoral (along the neck).
- (2) Branch from lateral circumflex femoral (along the neck).
These arteries pierce the capsule and ascend to the neck and head along the retinacular fibers.
- (3) Branch of obturator artery (along the ligament of the head).
- (4) Nutrient branch from the 2nd or 3rd perforating artery (branches of profunda femoris artery). This branch ascend from the shaft to the neck and then to the head.



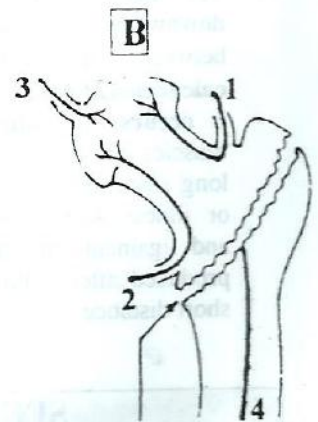
Fracture of the neck of the femur

A. In fractures near the head (intracapsular): the head of the femur dies due to insufficient blood supply along the ligament of the head of femur (a vascular necrosis).

B. In fractures near the trochanters (extracapsular, trochanteric): the head and neck have blood supply and will not die.

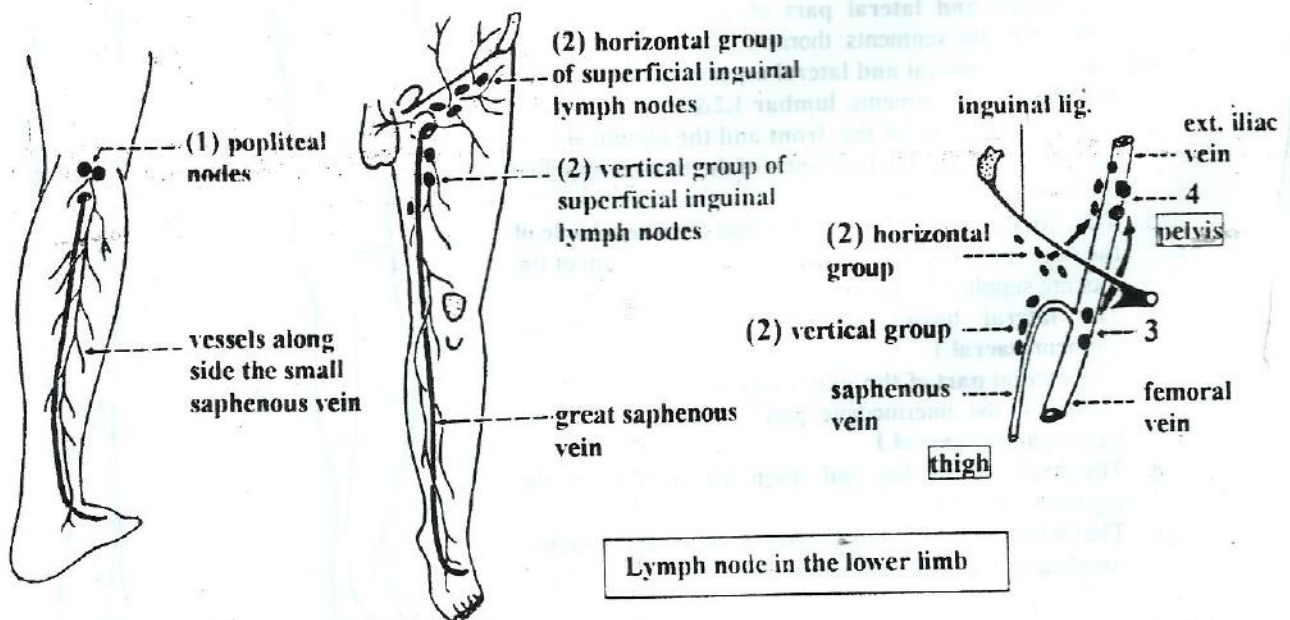


Fracture near the head of the femur (intracapsular)



Fracture near the greater trochanter of femur (extracapsular)

Lymph nodes and vessels of the lower limb



Lymph node in the lower limb

Superficial vessel: are numerous they from a dense plexus in the sole (plantar plexus). Most of the vessels ascend to the dorsum of the foot and in front of the ankle joint. The greater number of these vessels with vessels from the leg and thigh accompany the small & great saphenous veins and end in the popliteal lymph nodes(1) and also in the superficial inguinal lymph nodes(2).

Deep vessels: are very few. They drain the structure underneath the deep fascia. They run along the main vessels. They end mostly in the deep inguinal lymph nodes(3). Some vessels are interrupted in the anterior tibial or popliteal nodes.

Anterior tibial lymph node

This is a small lymph node along upper part of the anterior tibial vessels.

Popliteal lymph nodes(1)

These are small lymph nodes along the popliteal vessels. They receive some of the deep vessels and few vessels that run along the small saphenous vein. They send efferents along the femoral vessels to the deep inguinal lymph nodes.

Superficial inguinal lymph nodes(2)

These are the main nodes of the lower limb. They lie in the superficial fascia below the inguinal ligament. they are 2 groups (horizontal & vertical) described in page 30.

Deep inguinal lymph nodes(3)

These are few lymph nodes that lie close to the upper part of the femoral vein. They receive vessels from the superficial inguinal lymph nodes and deep vessels from the lower limb, perineum and popliteal lymph nodes. Their efferents ascend behind the inguinal ligament to end in the external iliac lymph nodes(4).

Femoral hernia: described on page 65

Nerve lesions



Femoral nerve lesion

1. Paralysis of the quadriceps femoris leading to loss of extension of knee joint.
2. Diminished cutaneous sensation on the front and medial side of the thigh.
3. Diminished cutaneous sensation on the medial aspect of the leg and medial border of the foot.

Sciatic nerve lesion

1. Paralysis of hamstring muscles leading to weakness of flexion of knee joint.
2. Paralysis of all muscles of the leg and foot, i.e. all muscles below of the knee. This leads to a condition of "flail foot".
3. Paralysis of the intrinsic muscles of the foot leading to clawing of the toes, i.e. flexion of the interphalangeal and extension of the metatarso-phalangeal joints.
4. Loss of cutaneous sensations on the leg and foot except the medial side of the leg and foot.

If the lesion is below the gluteal region, the hamstring muscles escape paralysis because of the high origin of the nerves supplying them.

Lateral popliteal (common peroneal) nerve lesion: described on page 67

Medial popliteal nerve lesion

1. Paralysis of muscles of posterior compartment of the leg leading to weakness of plantar flexion. The foot is dorsi flexed and everted.
2. Paralysis of the intrinsic muscles of the foot leading to clawing of the toes.
3. Loss of cutaneous sensations on the lower part of the back of the leg and sole of the foot.

Important anastomoses



Cruciate anastomosis:

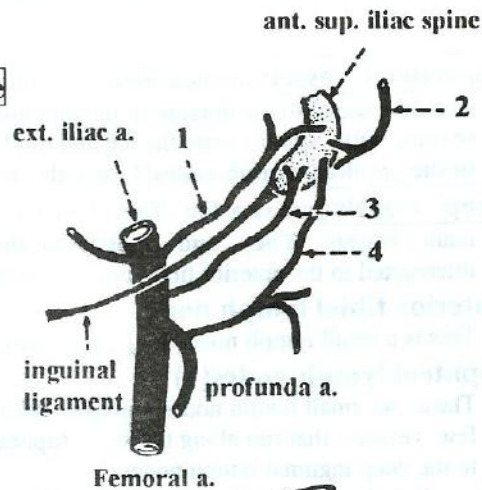
In the upper most part of the back of the thigh anastomosis occurs between four arteries, resembling a cross. described on page 41.

Anastomosis around anterior superior iliac spine

It is between branches from external iliac artery, internal iliac artery, and femoral artery.

The arteries are:

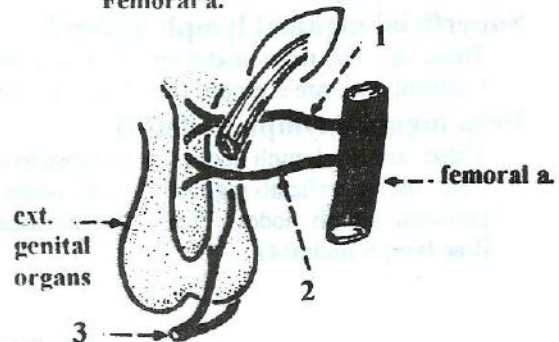
1. Deep circumflex iliac artery (branch from external iliac artery).
2. Superior gluteal artery (branch from internal iliac artery).
3. Superficial circumflex iliac artery (from femoral).
4. Ascending branch from lateral circumflex femoral (branch from profunda femoris which is branch of femoral artery).

**Anastomosis around external genital organs**

It is between branches from internal iliac artery and femoral artery.

The arteries are:

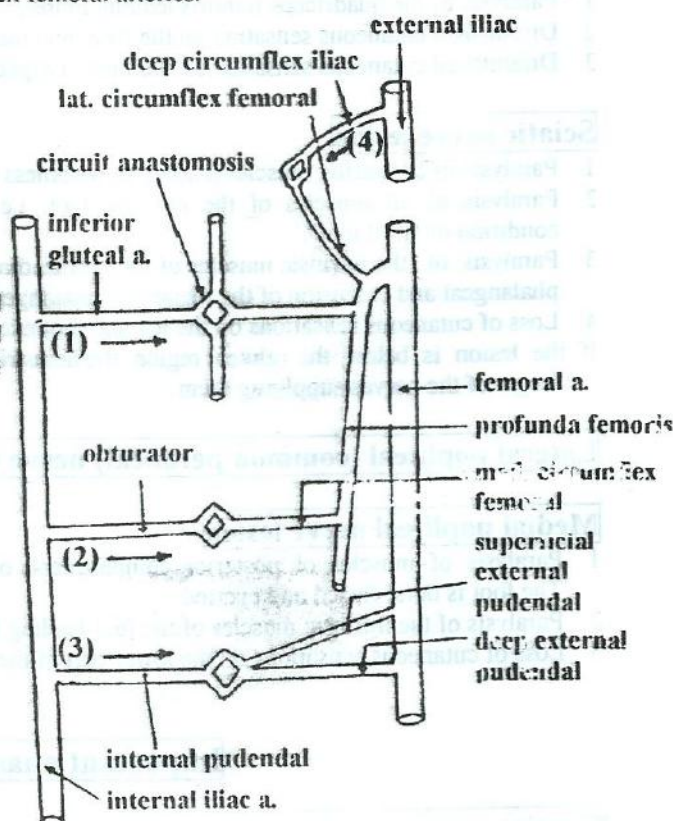
1. Deep external pudendal (branch from femoral).
2. Superficial external pudendal (branch from femoral).
3. Scrotal branches of internal pudendal (branch from internal iliac artery).

**Collateral circulation after ligation of the external iliac artery distal to the origin of its branches**

1. Anastomosis between the pubic branches of the inferior epigastric and obturator arteries.
2. Anastomosis around the anterior superior iliac spine between the deep circumflex iliac artery and the superficial circumflex iliac and lateral circumflex femoral arteries.
3. Anastomosis around external genital organs.
4. Cruciate anastomosis.

Collateral circulation after ligation of the femoral artery above the origin of the profunda artery**The blood passes:**

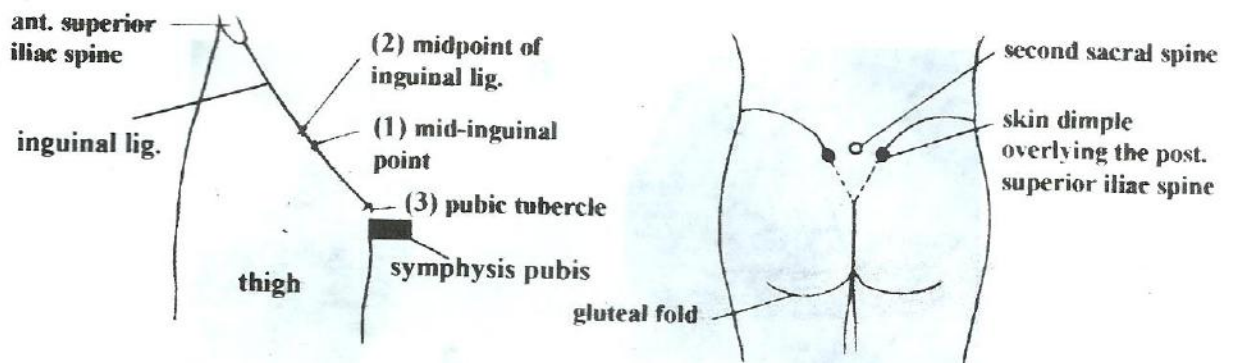
1. From inferior gluteal artery (branch of internal iliac) to the medial and lateral circumflex femoral and the first perforating arteries (branches profunda femoris) (cruciate anastomosis).
2. From the obturator artery (branch of internal iliac) to the medial circumflex femoral (branch of profunda femoris).
3. From the internal pudendal artery (branch of internal iliac) to the superficial and deep external pudendal (of femoral) (anastomosis around the external genital organs).
4. From the deep circumflex iliac artery (branch of external iliac) to the lateral circumflex femoral (branch of profunda femoris), and superficial circumflex iliac (branch of femoral). (anastomosis around the ant. superior iliac spine)



Anastomosis around the knee see page 109

Anastomosis around the ankle see page 112

SURFACE MARKINGS



Mid-inguinal point(1): a point on the inguinal ligament midway between the anterior superior iliac spine and symphysis pubis. It is not the **mid-point of the inguinal ligament(2)**.

Pubic tubercle(3): is the small bony projection felt just above the tendon of origin of adductor longus, when the thigh is abducted.

Posterior superior iliac spine(4): can be felt in the flexor of a skin dimple above the buttock. It lies opposite the second sacral spine.

Saphenous opening (described on page 31): its center is one and half inches below and lateral to the pubic tubercle.

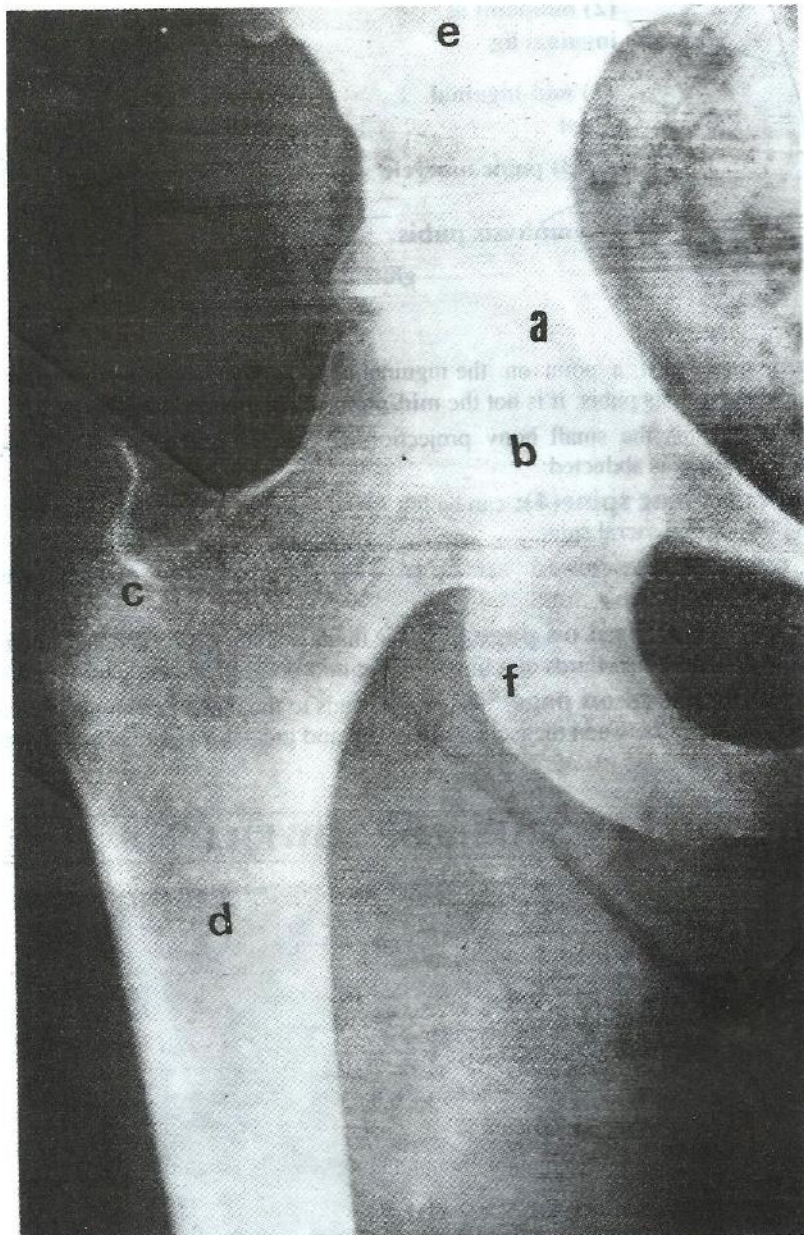
Femoral artery (described on page 57): the thigh is abducted, flexed and rotated laterally. It corresponds to the upper two-thirds of a line from the mid-point to the adductor tubercle.

Sciatic nerve (described on page 56): corresponds to the upper two-thirds of a line extending from a point midway between the ischial tuberosity and greater trochanter to the mid-point of the popliteal fossa.

RADIOGRAPHS OF LOWER LIMB

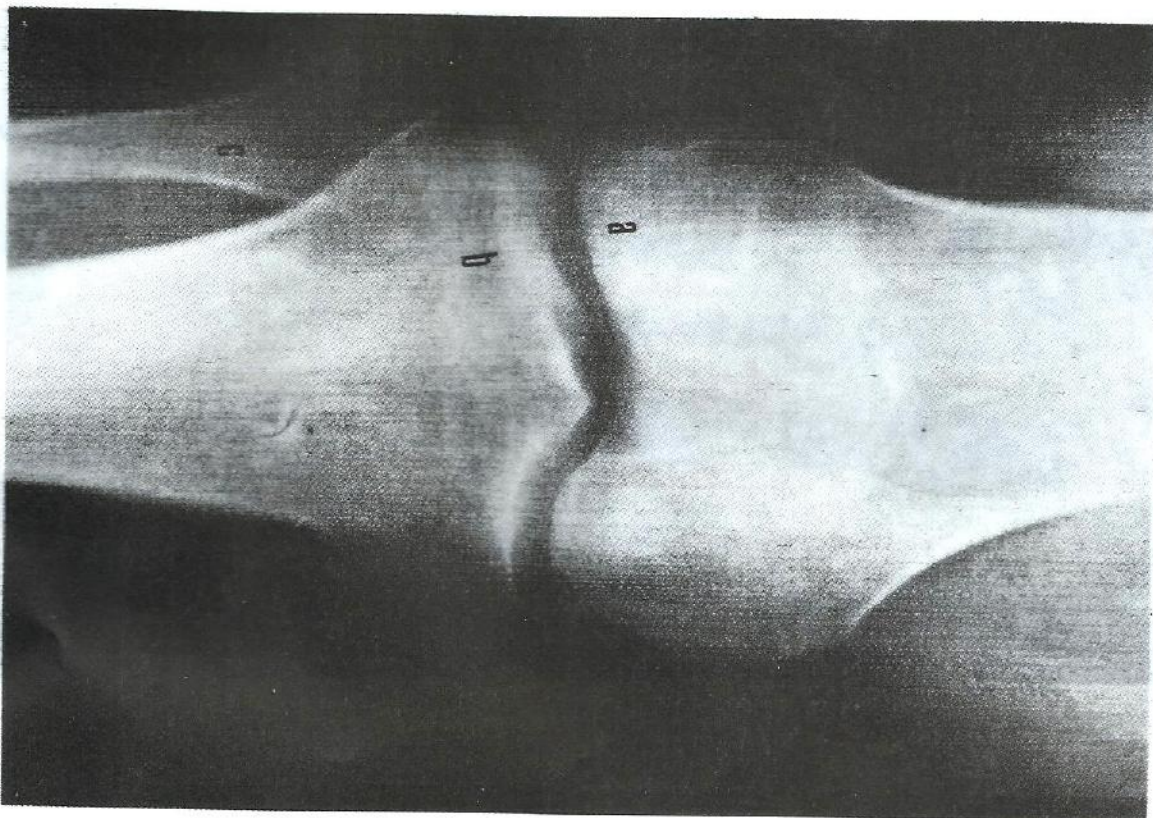


Hip joint - antero-posterior view - before puberty.
The triradiate cartilage of acetabulum is present.

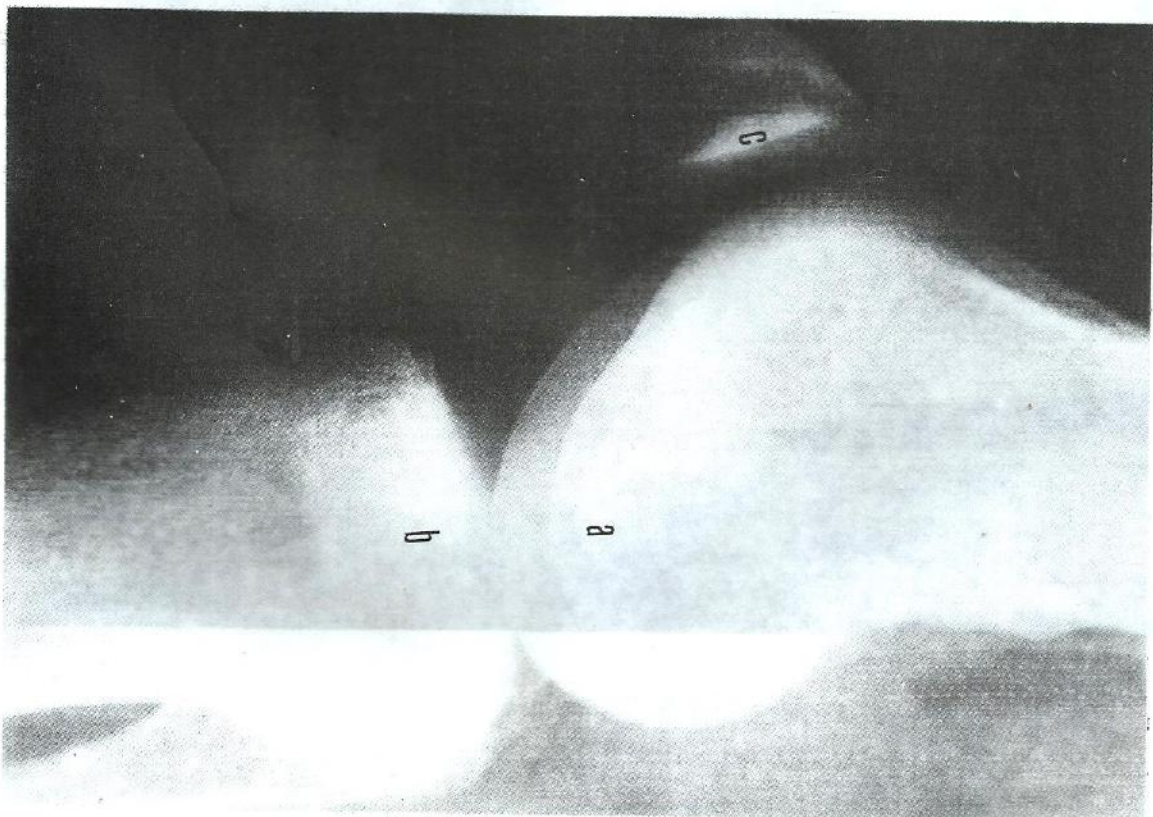


Hip joint - antero-posterior view - adult.

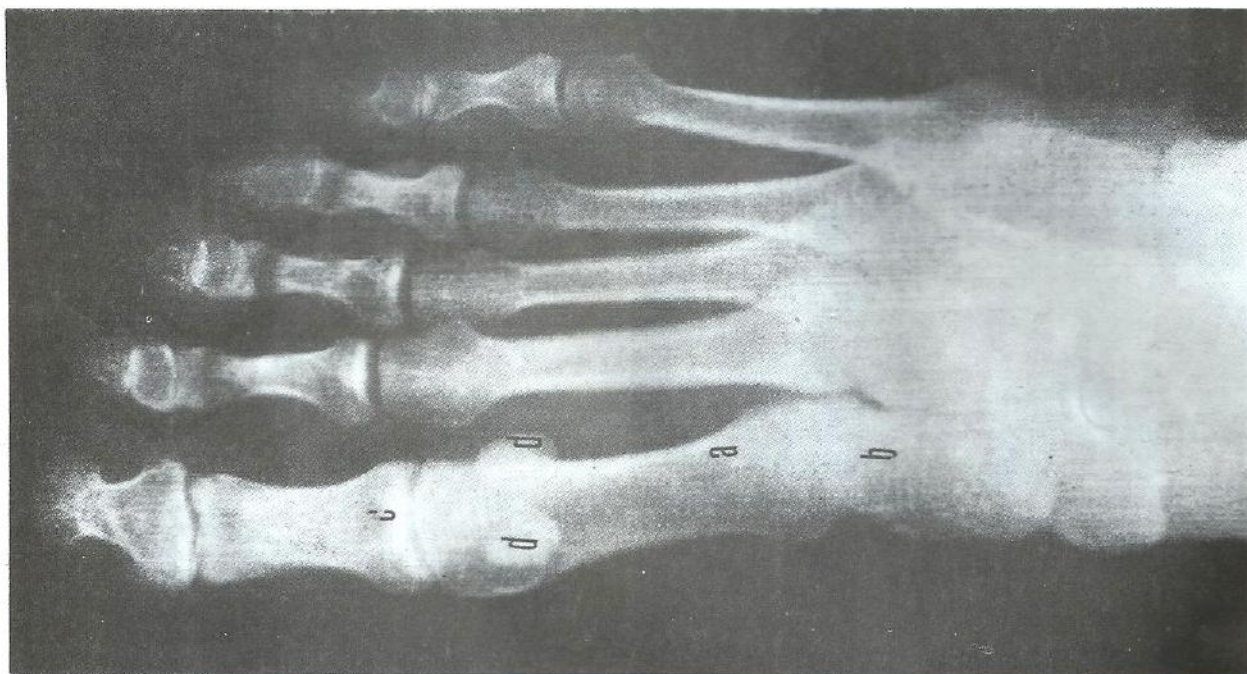
a = Acetabulum, b = head of femur,
c = greater trochanter, d = shaft femur,
e = ilium, f = ischial tuberosity.



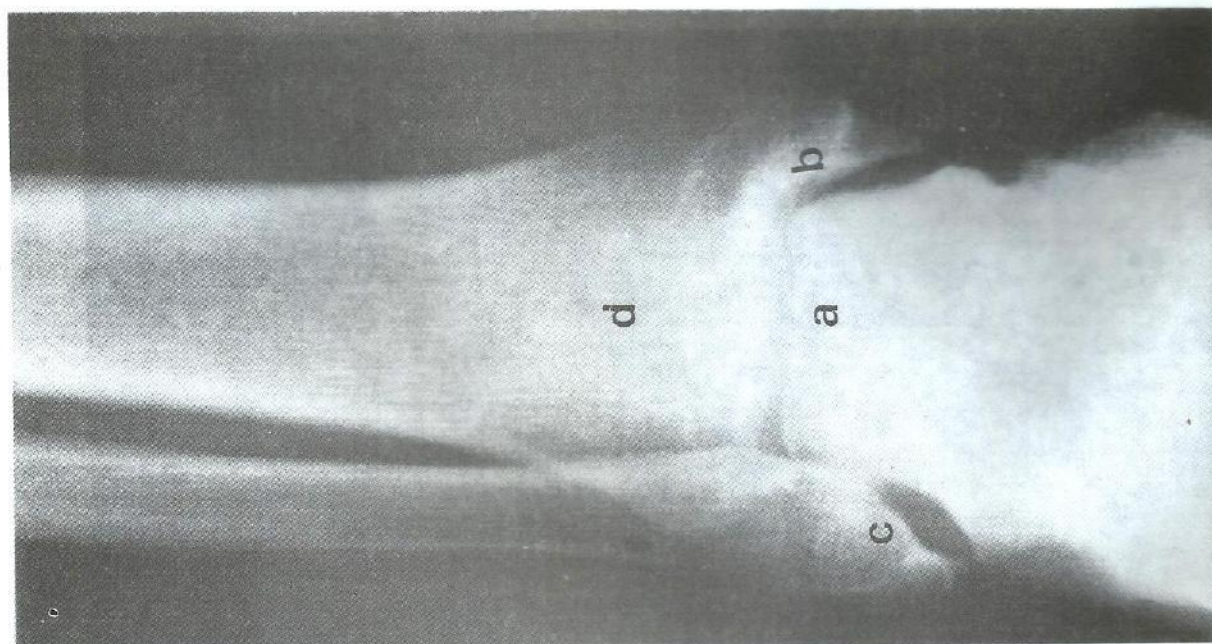
Knee joint - antero-posterior view - adult.
 a = condyle of femur, b = condyle of tibia, c = fibula.



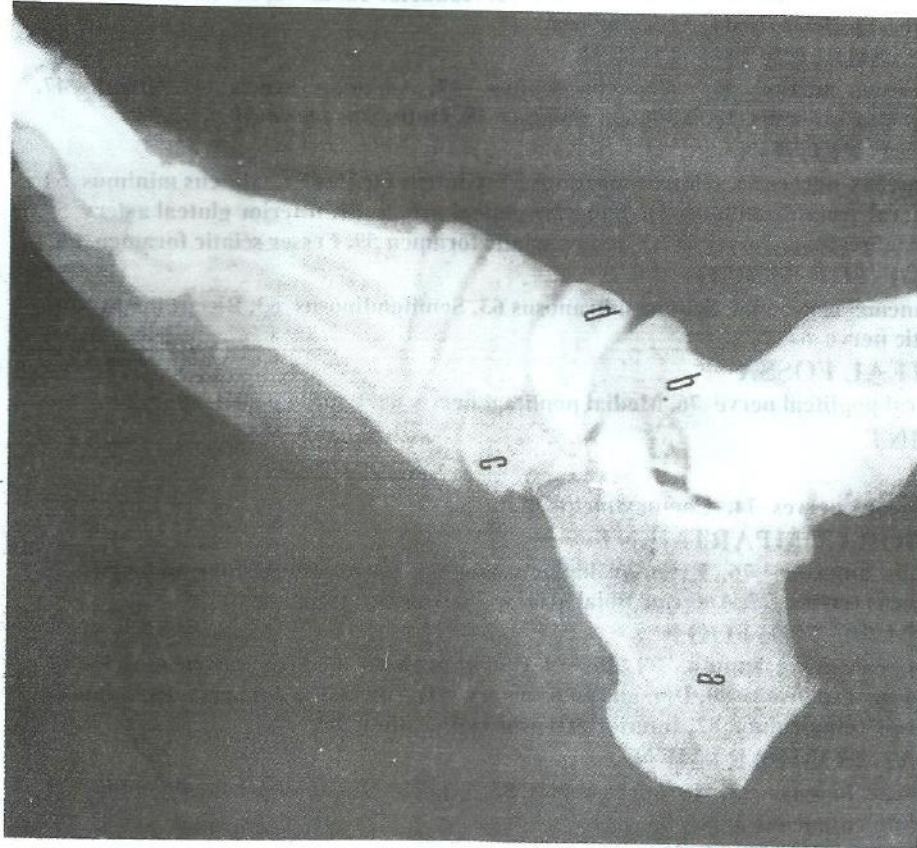
tibia - view lateral - adult
 a = condyle of femur, b = condyle of tibia, c = fibula.



Skeleton of foot - antero-posterior view - adult.
 a = first metatarsal, b = medial cuneiform, c = proximal phalanx of large toe, d = sesamoid bone.



Ankle joint - antero-posterior view.
 a = trochlea of talus, b = medial malleolus, c = lateral malleolus, d = tibia.



Lateral radiograph of adult foot.

**a = calcaneus, b = talus,
c = cuboid, d = navicular.**

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Lower Limb

Summary & Illustrations

